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PRESTORMING™
TEST BOOKLET
GENERAL STUDIES - PAPER – I
SCIENCE & TECHNOLOGY
TEST – 05

T.B.C : P-SIA-A-GS
Serial : P-GSI-242505

Test Booklet Series

A

Time Allowed : Two Hours ***Maximum Marks : 200***

I N S T R U C T I O N S

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2. ENCODE CLEARLY THE TEST BOOK SERIES **A, B, C** OR **D** AS THE CASE MAY BE IN THE APPROPRIATE PLACE IN THE ANSWER SHEET.
3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. *DO NOT* write **anything else** on the Test Booklet.
4. This Test Booklet contains **100 items** (questions). Each item is printed in **English.** Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose **ONLY ONE** response for each item.
5. You have to mark all your responses **ONLY** on the separate Answer Sheet provided. See directions in the Answer Sheet.
6. All items carry equal marks.
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9. Sheets for rough work are appended in the Test Booklet at the end.
10. **Penalty for Wrong answers :**

THERE WILL BE A PENALTY FOR WRONG ANSWERS MARKED BY A CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

(i) There are four alternatives for the answer to every question. For each question for which a wrong answer has been given by the candidate, **one-third (0.66)** of the marks assigned to that question will be deducted as a penalty.

(ii) If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be the same penalty as above to that question.

(iii) If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

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1. Consider the following statements :
   1. Artificial Intelligence systems learn from experiences and use them in decision-making.
   2. Machine learning makes predictions about new and unknown data with minimal errors.
   3. Natural Language Processing is used by search engines to suggest the next word in the sentence while typing keywords.

   How many of the above statements is/are correct ?
   (a) Only one
   (b) Only two
   (c) All three
   (d) None

2. Total internal reflection can take place when light travels from :
   1. Air to glass
   2. Glass to water
   3. Air to water
   4. Diamond to glass

   Select the correct codes from the options given below :
   (a) 1 and 3 only
   (b) 2 and 3 only
   (c) 1 and 4 only
   (d) 2 and 4 only

3. "It has the day temperature upto 430°C and night temperature upto -180°C. It takes 59 days to complete one rotation. It doesn't have moons. Its surface resembles the surface of the moon. It's gaseous outer layer has the greatest percentage of oxygen compared to other planets."

   The above description refers to which of the following planets ?
   (a) Mercury
   (b) Earth
   (c) Jupiter
   (d) Saturn

4. Consider the following statements with respect to Smart Cities Mission :
   1. It aims to promote cities that provide core infrastructure, a clean and sustainable environment and a decent quality of life to their citizens.
   2. It is a central sector scheme with a main focus on a sustainable and inclusive development approach.
   3. The Mission is under the Ministry of Rural Development

   Which of the statements given above is/are correct ?
   (a) 1 only
   (b) 1 and 2 only
   (c) 1 and 3 only
   (d) 2 and 3 only

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5. Consider the following statements :

Statement-I :

Graphite and diamond are isotopes of Carbon.

Statement-II :

Though Graphite and diamond are made of the same element, they have different physical properties and structural arrangements of atoms.

Which one of the following is correct in respect of the above statements ?

(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I

(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I

(c) Statement-I is correct, but Statement-II is incorrect

(d) Statement-I is incorrect, but Statement-II is correct

6. Recently, India's first space-based mission to study the Sun, Aditya L1, was launched. Which of the following detectors is used by the spacecraft to study the sun?

1. Electromagnetic detector
2. Particle detector
3. Magnetic Field detector
4. Doppler current profile detector

Select the answer using the codes given below:

(a) 1 and 2 only

(b) 1, 2 and 3 only

(c) 2, 3 and 4 only

(d) 1, 2, 3 and 4

7. Consider the following :

1. USA
2. Russia
3. Japan
4. China
5. India

How many of the countries mentioned above have Global Navigation Satellite Systems(GNSS) ?

(a) Only two

(b) Only three

(c) Only four

(d) All five

8. With reference to Indian biodiversity, Indian peafowl, black kite, and Giant Grey Shrike are:

(a) Birds

(b) Reptiles

(c) Amphibians

(d) Primates

9. Which of the following statements is correct ?

(a) The speed of the sound in a medium depends on the temperature of the medium.

(b) The speed of sound varies for different frequencies in a given medium under the same physical conditions.

(c) The speed of the sound in the solid medium is less than the speed of the sound in the gas medium at a constant temperature.

(d) All the above

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10. Consider the following statements :
    1. Unlike a free proton, a free neutron is unstable.
    2. Unlike Coulomb's law or Newton's law of gravitation, there is no simple mathematical form of the nuclear force.
    3. The nuclear force does not depend on the electric charge.

    Which of the statements given above is/are correct ?
    (a) 2 only
    (b) 1 and 2 only
    (c) 3 only
    (d) 1, 2 and 3

11. With reference to the Astra Mark 2 missile, consider the following statements :
    1. It is an air-to-air missile with a dual pulse solid rocket motor.
    2. It aims to target a range of over 100 km and will engage and destroy highly maneuverable supersonic aerial targets.
    3. It was designed and developed by the Defense Research and Development Laboratory (DRDL).

    Which of the above statements is/are correct ?
    (a) 1 only
    (b) 2 and 3 only
    (c) 1 and 3 only
    (d) 1, 2 and 3 only

12. Recently, India protested Chinese road construction at Shaksgam Valley, which is located at :
    (a) West of Gilgit
    (b) East of Aksai chin
    (c) North of Siachen glacier
    (d) South of Nubra valley

13. Consider the following statements :
    1. It consists of long chain molecules aligned in a particular direction.
    2. It works on the principle of Malus' law in physics.
    3. It can be used to control the intensity, sunglasses and windowpanes
    4. They are used in photographic cameras and 3D movie cameras.

    The above statements refer to which of the following ?
    (a) Prism
    (b) Polaroids
    (c) Optical fibres
    (d) Diffraction slit

14. Consider the following statements with respect to Free Space Optical Communication :
    1. It uses light propagating in free space to wirelessly transmit data for telecommunications.
    2. It utilises the infrared band of spectrum for data transmission.
    3. It can be used to transmit data between two points which have a direct line of sight.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

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15. Consider the following :
    1. Android
    2. Linux
    3. Mozilla Firefox
    4. VLC media player
    5. Python

    How many of the software mentioned above belong to the category of Open-source software (OSS) ?
    (a) Only two
    (b) Only three
    (c) Only four
    (d) All five

16. Consider the following countries :
    1. Canada
    2. France
    3. India
    4. Russia
    5. Japan
    6. United States

    Which of the above countries are part of the G7 grouping countries ?
    (a) 1, 2, 3 and 4 only
    (b) 2, 3, 4 and 5
    (c) 1, 2, 5 and 6
    (d) 1, 3, 5 and 6

17. "Photolithographic technology", recently seen in the news, is related to which of the following ?
    (a) Production of semiconductors
    (b) Protein synthesis prediction
    (c) Bio 3D printing
    (d) Remote sensing technology

18. Consider the following :
    1. Prithivi II missile
    2. Agni IV missile
    3. DHANUSH missile
    4. BRAHMOS missile

    Which of the above-mentioned are ballistic missiles currently operational in the Indian Defence Force ?
    (a) 1 only
    (b) 1 and 2 only
    (c) 2 and 3 only
    (d) 3 and 4 only

19. Consider the following statements :
    1. Higher concentrations of this pollutant damage the leaves of plants and retard the rate of photosynthesis.
    2. It is a lung irritant that can lead to an acute respiratory disease in children.
    3. It is harmful to various textile fibres and metals.
    4. It is a secondary pollutant which is toxic to living tissues.

    Which of the following statements refer to the above pollutants ?
    (a) Carbon dioxide
    (b) Nitrogen dioxide
    (c) Volatile organic compounds
    (d) Sulphur oxide

20. Consider the following statements regarding Diplomatic passports :
    1. Like normal passports, diplomatic passports are valid for 10 years.
    2. Diplomatic passports are also provided to relatives and immediate families of officers employed in the Indian Foreign Service (IFS).
    3. Holders of diplomatic passports are entitled to certain privileges and immunities as per international law.

    Which of the statements given above is/are correct ?
    (a) 2 only
    (b) 1 and 2 only
    (c) 3 only
    (d) 2 and 3 only

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21. Consider the following statements with reference to mass and energy :
    1. Both matter and energy can neither be created nor destroyed.
    2. Though energy can be transformed from one form to another, the total energy of an isolated system remains constant.
    3. Though the principle of conservation of energy cannot be proved, no violations have ever been observed.

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

22. Consider the following pairs :

S.No	***Scientific technologies***		***Principles***
1.	Tokamak	-	Magnetic confinement of plasma
2.	Neuromorphic computing	-	Spiking neural network
3.	Optical fibres	-	Total internal reflection of light

    How many of the above pairs are correctly matched ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

23. With respect to Missions to planet Mars, consider the following statements :
    1. The Mars Orbiter Mission is the India's first interplanetary mission to study the Martian surface features, morphology and mineralogy and return the samples to the Earth.
    2. The MAVEN mission is the first mission by NASA to study the Martian upper atmosphere.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

24. The 'Helmand, Harirod-Murghab, Panj-Amu' are the river basins of which among the following countries ?
    (a) Afghanistan
    (b) Bhutan
    (c) Nepal
    (d) Bangladesh

25. Consider the following statements :
    1. The surface web search engines cannot discover or display results for web pages within the dark web.
    2. The dark web is hidden by various network security measures like firewalls and encryption.
    3. The peer-to-peer (P2P) overlay network technique is used to TOR browsers to provide access to dark web.

    Which of the statements given above is/are ***not*** correct ?
    (a) 1 only
    (b) 1 and 2 only
    (c) 3 only
    (d) None

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26. End-to-end encryption (E2EE) is a type of messaging that keeps messages private from everyone, including the messaging service. How many of the following apps used in India has E2EE Facility ?
    1. What's App
    2. Telegram
    3. Gmail
    4. Instagram
    5. Facebook

    Choose the correct answer using the codes given below :
    (a) Only two
    (b) Only three
    (c) Only four
    (d) All five

27. Which of the following is ***not*** an example of exothermic reactions ?
    (a) Burning of natural gas
    (b) Decomposition of vegetable matter into compost.
    (c) Decomposition of calcium carbonate to calcium oxide and carbon dioxide on heating.
    (d) Breaking down of carbohydrates to form glucose, combines with oxygen to provide energy.

28. Which of the following States has banned oleander flowers in temple offerings after a woman died accidentally chewing the leaves of the oleander plant ?
    (a) Kerala
    (b) Tamil Nadu
    (c) Uttar Pradesh
    (d) Haryana

29. Consider the following statements :

    Statement 1 :

    The Gravitational force plays a key role in the formation and evolution of stars, galaxies and galactic clusters.

    Statement 2 :

    The gravitational force is the weakest force among the Fundamental forces in nature.

    Which one of the following is correct in respect of the above statements ?
    (a) Both Statement I and Statement II are correct, and Statement II is the correct explanation of Statement I
    (b) Both Statement I and Statement II are correct, but Statement II is not the correct explanation of Statement I
    (c) Statement I is correct, but Statement II is incorrect
    (d) Statement I is incorrect, but Statement II is correct

30. With reference to Multiple Independently Targetable Re-entry Vehicle (MIRV) technology, consider the following statements :
    1. It enables single missiles to target multiple locations hundreds of kilometres apart.
    2. India's longest-range ballistic missile, Agni-V, has been tested with this technology recently.
    3. MIRV-equipped missiles can be launched from land only.

    Which of the statements given above are correct ?
    (a) 1 only
    (b) 1 and 2 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

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31. With respect to Electronic Fiber, consider the following statements :
    1. It utilises the human body as part of the Circuit.
    2. It enables wireless visual–digital interactions.
    3. It can work without the need for batteries or chips

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

32. Consider the following statements :
    1. The temple in Hampi is a prime example of Dravidian architecture.
    2. The sanctum sanctorum houses the Shiva lingam, the main object of worship.
    3. The temple is a UNESCO World Heritage Site.
    4. The temple gained prominence and underwent extensive expansion in the 14th century during the Vijayanagara Empire.

    Which of the following temples is described above ?
    (a) Chandikeswara temple
    (b) Virupaksha temple
    (c) Chausath yogini temple
    (d) Someshwara temple

33. Consider the following statements regarding the Agnibaan SoRTed-01 mission :
    1. It is India's first semi-cryogenic engine-powered rocket launched from a private launch pad.
    2. It is the world's first single-piece engine designed and built indigenously through additive manufacturing.
    3. The purpose of the mission is to serve as a test flight and to demonstrate the in-house and home grown technologies.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

34. Consider the following parts of a plant :
    1. Petiole
    2. Lamina
    3. Stamens
    4. Pistil
    5. Reticulate

    How many of the above are parts of a flower ?
    (a) Only two
    (b) Only three
    (c) Only four
    (d) All five

35. With reference to the Small Satellite Launch Vehicle (SSLV), consider the following statements :
    1. It can carry payloads weighing up to 500 kg.
    2. The launch vehicle can be assembled in less than a week by a much smaller team.
    3. Currently, India has a share of participation of about 22% in the space economy along with Australia and Russia.

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

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36. In which one of the following groups are all four countries members of BIMSTEC ?
(a) Brazil, Iran, Saudi Arabia and Vietnam
(b) Indonesia, Japan, South Korea and Singapore
(c) Australia, Canada, Malaysia and New Zealand
(d) India, Sri Lanka, Nepal and Thailand

37. "Tetra chloroethene" is a compound that contaminates the groundwater and is a suspected carcinogen. It is most likely used as a solvent in which of the following ?
(a) Bleaching of Paper
(b) Food Preservatives
(c) Solution to Clean Turbid Water
(d) Dry Cleaning of Clothes

38. Consider the following statements :
Statement 1 :
Clean water would have more BOD value than highly polluted water.
Statement 2 :
The amount of Biological Oxygen Demand in the water measures the amount of organic material in the water.
Which one of the following is correct in respect of the above statements ?
(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation of Statement I
(b) Both Statement I and Statement II are correct, but Statement II is not the correct explanation of Statement I
(c) Statement I is correct, but Statement II is incorrect
(d) Statement I is incorrect, but Statement II is correct

39. Consider the following statements :
1. The photoelectric emission is an instantaneous process that involves the conversion of electrical energy into light energy.
2. All free electrons in a metal have the same energy.
Which of the statements given above is/are correct ?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

40. The term "Stellaria mcclintockiae", recently seen in the news, is related to :
(a) Plant species found in western ghats
(b) Butterfly species found in eastern ghats
(c) Bird species found in western ghats
(d) A mammal found in Himalayas

41. With reference to semiconductors, consider the following statements :
1. Electric vehicles use power management chips with high voltage and current applications.
2. At zero kelvin temperature, intrinsic semiconductors show properties similar to insulators.
3. Doping helps in increasing the conductivity of a pure semiconductor.
4. Light-emitting diodes are heavily doped semiconductors that convert mechanical energy into light.
Which of the above statements is/are correct ?
(a) 1, 2 and 4 only
(b) 2, 3 and 4 only
(c) 1, 2, 3, and 4
(d) 1, 2 and 3 only

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42. Which of the following best describes "SAGA-220" ?

(a) An AI tool to determine the age of a foetus in a pregnant woman

(b) A supercomputer developed by ISRO

(c) A Supersonic missile developed by DRDA

(d) A new variety of cocoa developed by ICAR

43. Which of the following statements is ***not*** correct with reference to "2024 PT5", recently seen in the news ?

(a) It is an asteroid that has been pulled into Earth's orbit, making it a temporary "mini-moon."

(b) It originates from a group of Near-Earth asteroids that share a similar orbit around the sun as Earth.

(c) It will circle the Earth for only 57 days before resuming its journey through space.

(d) It is the first such event to be reported in more than a century

44. Recently, for the first time, India has set up its own pavilion at the World Hydrogen Summit 2024, which was held in :

(a) Stockholm, Swedan

(b) Rotterdam, Netherland

(c) Berlin, Germany

(d) Brussels, Belgium

45. According to this phenomenon, while approaching a stationary source of sound with high speed, the pitch of the sound heard appears to be higher than that of the source and as the distance between observer and the source increases, the observed pitch becomes lower than that of the source. It is commonly used to check overspeeding of vehicles. This phenomenon also has applications in areas such as the military, medical science, astrophysics, etc.

Which of the following denotes the above described phenomenon ?

(a) Theory of sonics

(b) Fizeau effect

(c) Tyndall effect

(d) Doppler effect

46. Arrange the following phenomena in the order of increasing energy in terms of Joules :

1. Thunderstorm
2. Big bang
3. Rotational energy of the earth
4. Energy to break one bond in DNA

Select the correct answer using the code given below :

(a) 1-3-2-4

(b) 4-1-3-2

(c) 2-3-1-4

(d) 3-4-2-1

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47. Consider the following statements :

Statement-I :

The light passing into the event horizon of the Black Hole cannot escape into space.

Statement II :

In the Event horizon, the escape velocity is greater than the velocity of light.

Which one of the following is correct in respect of the above statements ?

(a) Both Statement-I and Statement-II are correct, and Statement-II explains Statement-I

(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I

(c) Statement I is correct, but Statement II is incorrect

(d) Statement I is incorrect, but Statement II is correct

48. Consider the following statements regarding Naegleria fowleri :

1. It is a free-living amoeba or a single-celled living organism
2. It causes a rare contagious disease that affects the central nervous system.
3. It is found at very low temperatures that are conducive to its growth and can survive for short periods in warm environments.

Which of the statements given above is/are correct ?

(a) 1 only

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

49. Consider the following rows with respect to Chandrayan 3 :

Sl. No.	***Payload***	***Placed In***	***Objective***
1.	Langmuir probe	Lander	To measure the near-surface plasma density.
2.	Alpha Particle X-ray Spectrometer	Rover	To determine the element composition of lunar soil.
3.	LASER Retroreflector Array	Lander	to understand the dynamics of the Moon system
4.	Spectro-polarimetry of Habitable Planet Earth	Propulsion Module	Future discoveries of smaller planets

In How many of the above rows is the given information correctly matched ?

(a) Only one

(b) Only two

(c) Only three

(d) All four

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50. Consider the following statements with respect to Gaganyaan Mission :
    1. The development of the first module of Bharatiya Anthariksh Station - India's Own Space Station is done under this mission.
    2. The CE20 cryogenic engine of ISRO is to be used in the Human Rated Launch Vehicle of Gaganyan Mission.
    3. After the human spaceflight, the Gaganauts will be landed back on the Landing Complex built at the Satish Dhawan Space Centre, Sriharikota.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

51. Consider the following statements :

    Statement I :

    The moon has no atmosphere on its own.

    Statement II :

    Since the radius and acceleration due to the gravity of the moon are small, the escape velocity of the moon is five times smaller than the Earth.

    Select the correct answer using the code given below :
    (a) Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I.
    (b) Both Statement I and Statement II are true, but Statement II is not the correct explanation of Statement I.
    (c) Statement I is true but Statement II is false
    (d) Statement I is false but Statement II is true.

52. Which article of the Indian Constitution provides a constitutional safeguard ensuring that a person who is arrested shall not be detained without being informed of the grounds for arrest and shall not be denied the right to consult and be defended by a legal practitioner ?
    (a) Article 21
    (b) Article 22
    (c) Article 24
    (d) Article 25

53. Consider the following statements with reference to a mirage :
    1. The refractive index of air decreases with its density.
    2. In colder regions, Objects appear to be elevated or floating above the horizon during mirage.
    3. Mirages can be observed in hot deserts and travelling on a vehicle during hot summers.

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

54. Consider the following :

    "It is a collective network of connected devices and the technology that facilitates communication between devices and the cloud and between the devices themselves. It allows them to collect and share data. Centres of Excellence have been established for this network at Bengaluru, Gurugram and Gandhi Nagar."

    The statements given above describe which of the following technologies ?
    (a) Block Chain Technology
    (b) Internet of Things
    (c) Metaverse
    (d) Augmented Reality

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55. Consider the following statements with respect to Quantum Key Distribution :

1. Quantum key distribution utilises the properties of quantum mechanics to develop a secure dedicated communications link.
2. In Public key encryption, the same key is used to encrypt and decrypt the message.
3. In Private key encryption, two different keys are used to encrypt and decrypt the message.

How many of the statements given above are correct ?

(a) Only one
(b) Only two
(c) All three
(d) None

56. Consider the following statements regarding Asset Reconstruction Companies :

1. It is a financial institution that buys non-performing assets or bad assets from banks and financial institutions to clean their balance sheets.
2. National Asset Reconstruction Company Limited (NARCL) is a government entity registered with the Reserve Bank of India as an Asset Reconstruction Company.

Which of the above statements is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

57. With respect to Huygens's principle, consider the following statements :

1. Waves from a point source spread out in all directions while light travel along narrow rays.
2. The limit of the ability of microscopes and telescopes to distinguish very close objects is set by the wavelength of light.

Which of the statements given above is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

58. Consider the following statements regarding the classification of missiles :

1. On the basis of propulsion, Aluminum powder is used as solid fuel and hydrocarbons are used in liquid propulsion technology.
2. In the wire guidance system, the command signals are passed along a wire dispensed from the missile, while in the Inertial guidance, accelerometers are used in control systems.

Which of the statements given above is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

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59. Consider the following statements with respect to NISAR Mission :
    1. It is the first Low Earth Orbit observatory being jointly developed by NASA and ISRO.
    2. It contains a high-frequency S-band radar developed by ISRO to obtain high-resolution data on surface deformation on Earth.
    3. The High-rate Science Downlink System and GPS receivers of the mission are to be indigenously developed by ISRO.

    Which of the statements given above are ***not*** correct ?
    (a) 1 only
    (b) 1 and 2 only
    (c) 3 only
    (d) 2 and 3 only

60. The World Economic Situation and Prospects (WESP) 2024 report was released by :
    (a) World Bank
    (b) United Nations
    (c) International Monetary Fund
    (d) Organization for Economic Co-operation and Development

61. Consider the following statements with respect to WEB 5.0 :
    1. It adds the feature of emotional intelligence to the internet.
    2. It provides complete control for the users to their data.
    3. It incorporates the semantic capabilities provided by Web 3.0.

    Which of the statement(s) given above is/are correct ?
    (a) 1 and 2 only
    (b) 1 and 3 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

62. Consider the following statements :
    1. Positronium is a fundamental atomic system comprising baryons and leptons.
    2. Electrons and Positrons interact through electromagnetic and weak forces.

    Which of the statements given above is/are ***not*** correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

63. Which of the following atmospheric phenomena is caused when a vertical beam of light appears to extend above and/or below a light source that develops as a result of ice crystals slowly falling through the air reflecting the sun's rays ?
    (a) Halos
    (b) Aurora
    (c) Sundogs
    (d) Sun Pillars

64. Consider the following statements regarding the World Wildlife Crime Report, 2024 :
    1. The Report focuses on trends in the illegal trade and assesses the causes and impacts of wildlife trafficking and associated crime globally.
    2. Based on seizure records, Coral pieces are the most frequently traded illegal item followed by live specimens like ornamental plants.
    3. The Report was released by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

    Which of the statements given above are correct ?
    (a) 1 and 2 only
    (b) 2 and 3 only
    (c) 1 and 3 only
    (d) 1, 2 and 3

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65. The Sky appears blue in colour because of,
    1. Absence of dust particles and air molecules at higher altitudes
    2. The shorter wavelengths of sunlight are scattered more than the longer wavelengths.

    Select the correct answer using the codes given below :
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

66. Which of the following astronomical phenomena can be classified as an 'Astronomical transients' ?
    1. Supernovae
    2. Active Galactic Nucleus
    3. Fast radio burst

    Select the correct answer using the codes given below :
    (a) 1 and 2 only
    (b) 1, 2 and 3 only
    (c) 1 and 3 only
    (d) 3 only

67. Consider the following statements with reference to forces of nature :
    1. Gravitational force is always attractive, unlike electromagnetic force, which can be attractive or repulsive.
    2. Unlike gravitational force, electromagnetic force needs an intervening medium to travel over large distances.
    3. Protons, neutrons, and electrons experience strong nuclear force equally.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) 2 and 3 only
    (d) 1 and 2 only

68. With respect to Poliomyelitis disease, consider the following statements :
    1. It is a contagious disease spread mainly through the faecal-oral route.
    2. The incubation period of the disease is 7–10 days.
    3. The Virus in the disease causes paralysis within a few hours of infection.
    4. Of the 3 strains of wild Poliomyelitis, type 1 remains only in two countries.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) Only three
    (d) All four

69. Consider the following statements :
    1. Geostationary Satellites remain stationary in the sky with respect to the ground stations, while Sun-Synchronous Satellites pass over a spot on Earth at a given time every day.
    2. Geostationary Satellites are widely used for telecommunications in India, whereas Sun Synchronous Satellites are preferred in remote sensing and imaging satellites.

    Which of the statements given above is/are ***not*** correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

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70. Consider the following statements with respect to Black Holes :
    1. They are huge concentrations of matter packed into very tiny spaces.
    2. The rings of gas surrounding the Black Hole emit X-rays.
    3. As moving away from the center of the black hole, the thickness of the rings reduces.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

71. Consider the following :

Sl. No.	*Moon*	*Belong to Planet*	*Description*
1.	Titan	Saturn	Only moon with a dense atmosphere like the earth
2.	Callisto	Jupiter	Second Largest moon in the solar system
3.	Europa	Saturn	Has atmosphere primarily composed of oxygen
4.	Triton	Neptune	Moon with Seasonal change and weather pattern

    In which of the above rows is the given information correctly matched ?
    (a) 1 and 2
    (b) 2 and 3
    (c) 3 and 4
    (d) 1 and 4

72. Consider the following statements regarding the Red List of Mangrove Ecosystems :
    1. It is the first-ever global assessment by the International Union for Conservation of Nature.
    2. Nearly one-third of the global mangrove ecosystem is affected due to global sea-level rise.
    3. The Eastern parts of India are categorised as vulnerable in the Red list of Mangrove Ecosystems.

    Which of the above statements is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) 1 and 2 only
    (d) 1 and 3 only

73. Which of the following devices is used for detecting an optical signal ?
    (a) Photodiodes
    (b) Light emitting diodes
    (c) Photovoltaic device
    (d) Invertor

74. Which of the following is the reason for an object to float when placed on the surface of water ?
    (a) The gravitational pull acting on the object is greater than the up thrust of water on the object.
    (b) The density of the object is greater than the density of the water
    (c) The density of the object is less than the density of the water
    (d) The up thrust of water on the object is less than the weight of the object.

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75. With reference to the Anti-Submarine Warfare Shallow Water Craft (ASW SWC) project, consider the following statements :
    1. The Mahe class of ASW SWC ships, named after ports of strategic importance along the Indian coast, will undertake anti-submarine operations and mine-laying operations.
    2. The ASW SWC ships with over 80% Indigenous content, which boosts India's progress towards 'Aatmanirbhar Bharat'.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

76. The Periodic Labour Force Survey was conducted by which of the following ministry ?
    (a) Ministry of Labour and Employment
    (b) Ministry of Finance
    (c) Ministry of Statistics and program implementation
    (d) Ministry of Home Affairs

77. Consider the following statements with regards to the components of food :
    1. Roughage or dietary fiber does not provide any nutrient to our body.
    2. Fats give much more energy as compared to the same amount of carbohydrates.
    3. Repeated washing of rice and pulses are important and its does not remove any of the vitamins and minerals present in them.
    4. All deficiency diseases can be prevented by taking a balanced diet.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) Only three
    (d) All four

78. With respect to the VIPER mission, consider the following statements:
    1. It is the first robotic Moon rover by ISRO.
    2. It is designed to search for volatile molecules, such as water and carbon dioxide, at lunar temperatures.
    3. During exploration, the rover will endure extreme temperature conditions, dynamic lighting, and complex terrain.

    Which of the statements given above are correct ?
    (a) 1 and 2 only
    (b) 2 and 3 only
    (c) 1 and 3 only
    (d) 1, 2 and 3

79. Consider the following statements :
    1. Conventionally, in an electric circuit, the direction of electric current is taken as the direction of the flow of electrons.
    2. The fuse material with high resistivity is connected in series with the electrical circuits as a safety device.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

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80. Consider the following statements regarding Thalassemia :
1. It is an inherited blood disorder that causes a body to have less haemoglobin than normal.
2. Thalassemia disease can be treated by a bone marrow transplant.

Which of the above statements is/are correct ?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

81. Consider the following statements :
1. Methane is the second most abundant anthropogenic greenhouse gas after carbon dioxide.
2. Methanogens play a crucial role in the global carbon cycle by converting organic matter into methane.
3. If the methane is from a biological source, there will be more carbon-13 atoms in 1000 molecules.

Which of the statements given above is/are correct ?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

82. Consider the following statements :
1. Neutron stars are extremely dense, which creates immense pressure that forces the neutrons into a quark matter.
2. Unlike electrons, protons and neutrons are composite particles made up of quarks.

Which of the statements given above is/are correct ?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

83. Consider the following statements :
Statement-I :
X-rays are capable of scanning the inside of the human body.
Statement-II :
X-rays have wavelengths between 0.01 to 10 nanometers, small enough to pass between atoms in many materials.
Statement-III :
Dense materials like bones reflect more X-rays and appear white on images.
Which one of the following is correct in respect of the above statements ?
(a) Both Statement-II and Statement-III are correct and both of them explain Statement-I
(b) Both Statement-II and Statement-III are correct, but only one of them explains Statement-I
(c) Only one of the Statements II and III is correct and that explains Statement-I
(d) Neither Statement-II nor Statement-III is correct

84. Consider the following pairs :

	Tradition		***State***
1.	Ambubachi Mela	-	Assam
2.	Raja Parba festival	-	Gujarat
3.	Mata ni pachedi paintings	-	Odisha

How many of the above pairs are correctly matched ?
(a) Only one
(b) Only two
(c) All three
(d) None

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85. Which of the following properties does Graphene, a 2-dimensional material, lack, posing a significant challenge to its use as a traditional semiconductor ?
(a) Flexibility
(b) Mechanical strength
(c) Natural Bandgap
(d) Electrical conductivity

86. If a large asteroid were to impact the Earth, which of the following are the possible effects on the Earth ?
1. Generation of massive tsunamis
2. Mass Extinction event
3. Large-scale wildfires
4. Impact winter

Select the correct codes from the options given below :
(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 2 and 4 only
(d) 1, 2, 3 and 4

87. Consider the following pairs :

Satellites / Telescopes		***Description***
1. PRATUSH	-	Radiometer in lunar orbit that will reveal the Cosmic Dawn of our Universe.
2. Long-Baseline Optical Imaging Interferometer	-	Study magnetic activity on stars and the centres of active galaxies in visible and ultraviolet wavelengths.
3. Queqiao-2	-	Relay satellite to support communications with the current Chang'e-4 mission

Which of the pairs given above are correct ?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

88. With reference to the Prime Minister's National Relief Fund (PMNRF), consider the following statements :
1. PMNRF was originally established to offer immediate relief during natural calamities.
2. In addition to public contributions, PMNRF also receives support from the annual budget.
3. All contributions to the PMNRF are exempt from Income Tax.

Which of the above statements is/are ***not*** correct ?
(a) 1 only
(b) 1 and 2 only
(c) 3 only
(d) 2 and 3 only

89. Consider the following statements :
1. A Geomagnetic storm happens when the particles from the Sun interact with the Earth's magnetic field.
2. Coronal Mass Ejections (CMEs) are large clouds of plasma and magnetic fields hurled into space from the Sun.

Which of the statements given above is/are correct ?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

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90. With reference to reflecting telescopes, consider the following statements :
    1. In reflecting telescopes, mirrors produce spherical aberration where the reflected light rays converge at separate focal points.
    2. In such a telescope, the objective mirror focuses light inside the telescope tube.
    3. The Sampurnanand Telescope at the Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, is the largest reflecting telescope in India for the study of celestial objects at optical wavelengths.

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

91. Consider the following statements with respect to High Altitude Pseudo Satellites :
    1. They are unmanned solar-powered vehicles operating in the troposphere.
    2. They are designed to bridge the gap between unmanned aerial vehicles flying at lower altitudes and conventional satellites in space.
    3. The aeroplanes, airships and balloons can act as High Altitude Pseudo Satellites.

    Which of the statements given above are correct ?
    (a) 1 and 2 only
    (b) 1 and 3 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

92. Lipulekh Pass is situated near the trijunction of India :
    (a) China and Nepal
    (b) Nepal and Bhutan
    (c) Bangladesh and Myanmar
    (d) Myanmar and China

93. Consider the following statements with respect to supercomputers :
    1. The efficiency of the supercomputers is high at lower temperatures.
    2. Their speed is measured in "FLOPS".
    3. "Param Shivey" is the fastest and largest AI supercomputer in India.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

94. "Beamforming is a technique used to improve the signal-to-noise ratio of received signals and eliminate undesirable interference sources". In this regard, which of the following has its applications ?
    1. Radio Detection and Ranging (RADAR)
    2. Sound Navigation and Ranging (SONAR)
    3. Medical imaging
    4. Seismology

    Select the correct answer using the codes given below :
    (a) 1 and 4 only
    (b) 2, 3 and 4 only
    (c) 3 and 4 only
    (d) 1, 2, 3 and 4

95. If a person holds a handkerchief close to his eyes and looks at the sun, it looks like circular fringes. Which of the following phenomena is responsible for the above description ?
    (a) Diffraction of light
    (b) Interference of light
    (c) Scattering of light
    (d) Polarisation

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96. Consider the following statements :

As per the Central Civil Services (Leave) (Amendment) Rules, 2024

1. A surrogate mother who is a government employee and has fewer than two surviving children can take 180 days of maternity leave.
2. It also allows both male and female government employees to take maternity leave if they have children through surrogacy.

Which of the above statements is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

97. With reference to types of asteroids in the solar system, consider the following statements :

1. Carbonaceous asteroids, or C-type asteroids, are the most common of all asteroid types.
2. Metallic M-type asteroids are more common than stony S-type asteroids.
3. C-type asteroids are the primary building blocks of terrestrial planets like the earth.

Which of the statements given above is/are correct ?

(a) 1 only
(b) 1 and 3 only
(c) 2 only
(d) 2 and 3 only

98. Consider the following pairs :

Types of Artificial Neural Networks		***Uses***
1. Convolutional Neural Networks	-	Speech recognition
2. Recurrent Neural Networks	-	Image and video processing
3. Generative Adversarial Networks	-	Deep fake
4. Generative Pre-trained Transformer	-	Natural language processing

Which of the pairs given above are correctly matched ?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 3 and 4 only
(d) 2 and 4 only

99. Consider the following :

1. Cloud burst
2. Hailstorm
3. Heat waves
4. Pest attack
5. Cold waves

How many of the disasters listed above are made eligible for funding from the National and State Disaster Response Funds in India ?

(a) Only two
(b) Only three
(c) Only four
(d) All five

100. Consider the following :

1. Sariska
2. Dampa
3. Pench
4. Melghat

Arrange the Tiger Reserves mentioned above in the North to South Direction using the codes given below.

(a) 3 – 1 – 2 – 4
(b) 2 – 3 – 1 – 4
(c) 4 – 3 – 1 – 2
(d) 1 – 2 – 3 – 4

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PRESTORMING – 2024-25

TEST 05 – SCIENCE & TECHNOLOGY - EXPLANATION

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1. Consider the following statements :
   1. Artificial Intelligence systems learn from experiences and use them in decision-making.
   2. Machine learning makes predictions about new and unknown data with minimal errors.
   3. Natural Language Processing is used by search engines to suggest the next word in the sentence while typing keywords.

   How many of the above statements is/are correct ?
   (a) Only one
   (b) Only two
   (c) **All three**
   (d) None

EXPLANATION:

AI, also known as Artificial intelligence, is a technology with human-like problem-solving capabilities. Artificial Intelligence endeavours to simulate the natural intelligence of human beings into machines, thus making them behave intelligently. An intelligent machine is supposed to imitate some of the cognitive functions of humans, like learning, decision-making and problem-solving. In order to make machines perform tasks with minimum human intervention, they are programmed to create a knowledge base and make decisions based on it. Artificial intelligence systems can also learn from past experiences or outcomes to make new decisions. **So, Statement 1 is correct.**

Machine translation is a rapidly emerging field where machines are already able to translate texts from one language to another with a fair amount of correctness.
While, Machine Learning is a subsystem of Artificial Intelligence wherein computers have the ability to learn from data using statistical techniques without being explicitly programmed by a human being. Machine learning comprises algorithms that use data to learn on their own and make predictions about new and unknown data. These algorithms, called models, are first trained and tested using training data and testing data, respectively. After successive training, once these models are able to give results to an acceptable level of accuracy. **So, Statement 2 is correct.**

The predictive typing feature of search engines that helps us by suggesting the next word in the sentence while typing keywords and the spell-checking features are examples of Natural Language Processing (NLP). It deals with the interaction between humans and computers using human-spoken languages, such as Hindi, English, etc. In fact it is possible to search the web or operate or control our devices using our voice. All this has been possible by NLP. An NLP system can perform text-to-speech and speech-to-text conversion, as depicted in the image below. **So, Statement 3 is correct.**

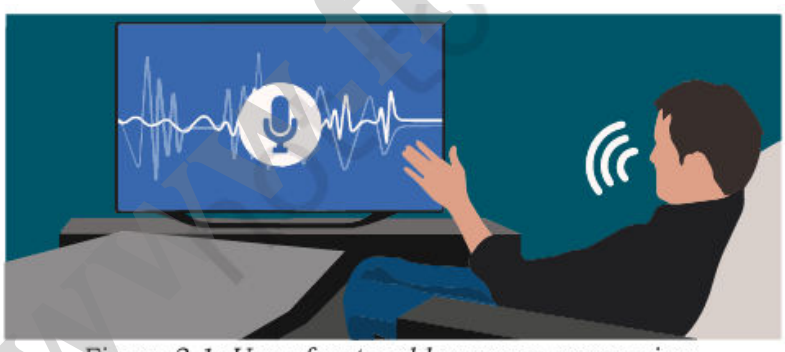

Figure 3.1: Use of natural language processing

ADDITIONAL INFORMATION:

EMERGING TRENDS	
Cloud Computing	➢ Cloud computing is an emerging trend in the field of information technology, where computer-based services are delivered over the Internet or the cloud, and it is accessible to the user from anywhere using any device. ➢ The services comprise software, hardware (servers), databases, storage, etc. These

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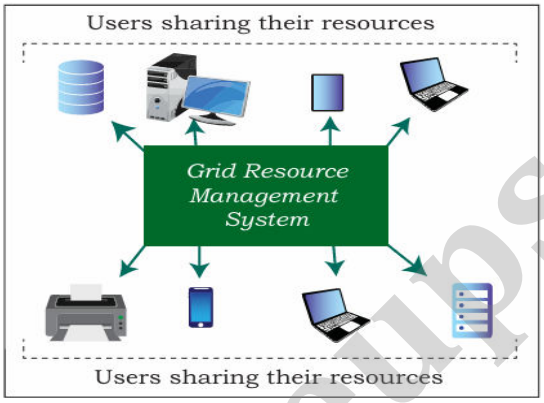
	resources are provided by companies called cloud service providers and usually charge on a pay-per-use basis, like the way we pay for electricity usage. ➢ Cloud services can be Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).
Grid Computing	➢ A grid is a computer network of geographically dispersed and heterogeneous computational resources. Unlike the cloud, whose primary focus is to provide services, a grid is more application-specific and creates a sense of a virtual supercomputer with enormous processing power and storage. ➢ The constituent resources are called nodes. These different nodes temporarily come together to solve a single large task and to reach a common goal. ➢ Grid can be of two types: • Data grid, used to manage large and distributed data having required multi-user access and • CPU or Processor grid, where processing is moved from one PC to another as needed or a large task is divided into subtasks and divided into various nodes for parallel processing.  *Figure 3.13: Grid computing*

2. Total internal reflection can take place when light travels from :
   1. Air to glass
   2. Glass to water
   3. Air to water
   4. Diamond to glass

   Select the correct codes from the options given below :

   (a) 1 and 3 only
   (b) 2 and 3 only
   (c) 1 and 4 only
   (d) 2 and 4 only

EXPLANATION:

When light travels from an optically denser medium to a rarer medium at the interface, it is partly reflected back into the same medium and partly refracted to the second medium. This reflection is called the internal reflection.

Total internal reflection, is a complete reflection of a ray of light within a medium such as water or glass from the surrounding surfaces back into the medium. The phenomenon occurs if the angle of incidence is greater than a certain limiting angle, called the critical angle.

When a ray of light enters from a denser medium to a rarer medium, it bends away from the normal. If the angle of incidence is greater than the critical angle, the incident ray will be reflected back in the same medium.

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Here in refractive index of Denser to rarer medium is Diamond (2.42) > Glass (1.52) > Water (1.33) > Air (1.0003).

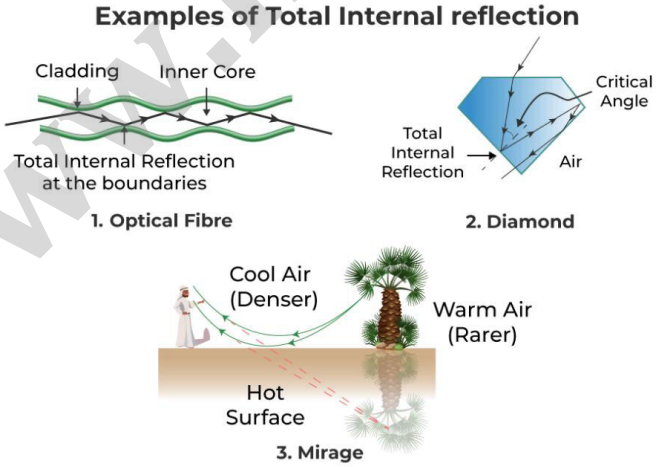
From Rarer medium to Denser medium Like, Air to Glass and Air to Water. Total Internal Reflection is does not occur. **So, Statement 1 and Statement 3 is not correct.**

From Denser medium to Rarer medium Like, Glass to Water and Diamond to Glass. Total Internal Reflection can take place. **So, Statement 2 and Statement 4 is correct.**

Material	Refractive Index
Air	1.0003
Water	1.33
Ice	1.31
Alcohol	1.36
Crown Glass	1.52
Diamond	2.42
Rock salt	1.54

ADDITIONAL INFORMATION:

APPLICATIONS OF REFRACTION AND TOTAL INTERNAL REFLECTION	
Mirage	Mirage is an optical illusion which is observed in deserts or on tarred roads in hot summer days. This, you might have observed, creates an illusion of water, which actually is not there. Due to excessive heat, the road gets very hot and the air in contact with it also gets heated up. The densities and the refractive indices of the layers immediately above the road are lower than those of the cooler higher layers. Since there is no abrupt change in medium a ray of light from a distant object, such as a tree, bends more and more as it passes through these layers. And when it falls on a layer at an angle greater than the critical angle for the two consecutive layers, total internal reflection occurs.
Optical Fibres	An optical fibre is a hair-thin structure of glass or quartz. It has an inner core which is covered by a thin layer (called cladding) of a material of slightly lower refractive index. This arrangement ensures total internal reflection. You can easily understand it, if you recall the conditions for total internal reflection.



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3. "It has the day temperature upto 430°C and night temperatureupto -180°C. It takes 59 days to complete one rotation. It doesn't have moons. Its surface resembles the surface of the moon. It's gaseous outer layer has the greatest percentage of oxygen compared to other planets."
   The above description refers to which of the following planets ?
   (a) Mercury
   (b) Earth
   (c) Jupiter
   (d) Saturn

EXPLANATION:

Mercury's surface temperatures are both extremely hot and cold. Because the planet is so close to the Sun, day temperatures can reach highs of 800°F (430°C). Without an atmosphere to retain that heat at night, temperatures can dip as low as -290°F (-180°C). Mercury doesn't have moons.

- Despite its proximity to the Sun, Mercury is not the hottest planet in our solar system that title belongs to nearby Venus. Mercury spins slowly on its axis and completes one rotation every 59 Earth days. But when Mercury moves fastest in its elliptical orbit around the Sun (and it is closest to the Sun), each rotation is not accompanied by sunrise and sunset like on most other planets. The morning Sun appears to rise briefly, set, and again from some parts of the planet's surface. The same thing happens in reverse at sunset for other parts of the surface. One Mercury solar day (one full day-night cycle) equals 176 Earth days – just over two years on Mercury.
- Mercury's surface resembles Earth's Moon, scarred by many impact craters resulting from collisions with meteoroids and comets.
- It's gaseous outer layer has the greatest percentage of oxygen compared to other planets. **So, Option (a) is correct.**

Object	Mass (kilograms)	Carbon Dioxide	Nitrogen	Oxygen	Argon	Methane	Sodium	Hydrogen	Helium	Other
Sun	$3.0x10^{30}$							71%	26%	3%
Mercury	1000			42%			22%	22%	6%	8%
Venus	$4.8x10^{20}$	96%	4%							
Earth	$1.4x10^{21}$		78%	21%	1%					<1%
Moon	100,000				70%		1%		29%	
Mars	$2.5x10^{16}$	95%	2.7%		1.6%					0.7%
Jupiter	$1.9x10^{27}$							89.8%	10.2%	
Saturn	$5.4x10^{26}$							96.3%	3.2%	0.5%
Titan	$9.1x10^{18}$		97%			2%				1%
Uranus	$8.6x10^{25}$					2.3%		82.5%	15.2%	
Neptune	$1.0x10^{26}$					1.0%		80%	19%	
Pluto	$1.3x10^{14}$	8%	90%			2%				

ADDITIONAL INFORMATION:

MERCURY RELATED MISSIONS	
Mariner 10	Mariner 10 was the first spacecraft sent to the planet Mercury, the first mission to explore two planets (Mercury and Venus) during a single mission, the first to return to its primary destination for another look, and the first to use a gravity assist to change its flight path.
BepiColombo	BepiColombo is an international mission comprised of two spacecraft riding together to Mercury to orbit and to study the planet from unique vantage points. The European Space Agency (ESA) provided one orbiter. The Japan Aerospace Exploration Agency (JAXA) supplied the second orbiter. ➢ BepiColombo launched in October 2018 and is scheduled to begin orbiting Mercury in 2025. ➢ ESA's Mercury Planetary Orbiter (MPO) will study the planet's surface and interior. ➢ JAXA's Mercury Magnetospheric Orbiter (MIO) will study the planet's magnetic field. ➢ These are the first Mercury missions for the ESA and Japan. Only two other spacecraft have visited Mercury: NASA's Mariner 10 and MESSENGER.

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MESSENGER	➢ MErcury Surface, Space ENvironment, GEochemistry, and Ranging. ➢ NASA's MESSENGER spacecraft orbited Mercury for more than four years. ➢ Among its accomplishments, the mission determined Mercury's surface composition, revealed its geological history, discovered details about its internal magnetic field, and verified its polar deposits are dominantly water-ice. ➢ The mission ended when MESSENGER slammed into Mercury's surface. The first spacecraft to visit Mercury in 30 years and the first ever to orbit, MESSENGER mapped the entire planet, discovered abundant water ice in shadows at the poles, and unlocked knowledge about Mercury's geology and magnetic field.

4. Consider the following statements with respect to Smart Cities Mission :
   1. It aims to promote cities that provide core infrastructure, a clean and sustainable environment and a decent quality of life to their citizens.
   2. It is a central sector scheme with a main focus on a sustainable and inclusive development approach.
   3. The Mission is under the Ministry of Rural Development.

   Which of the statements given above is/are correct ?
   (a) **1 only**
   (b) 1 and 2 only
   (c) 1 and 3 only
   (d) 2 and 3 only

EXPLANATION:

The Prime Minister of India launched the Smart Cities Mission on June 25 2015. The Mission's main objective is to promote cities that provide core infrastructure, clean and sustainable environment and give their citizens a decent quality of life through the application of 'smart solutions'. The Mission aims to drive economic growth and improve quality of life through comprehensive work on the city's social, economic, physical and institutional pillars. The focus is on sustainable and inclusive development through the creation of replicable models which act as lighthouses to other aspiring cities. A two-stage competition has selected one hundred cities to be developed as Smart Cities. **So, Statement 1 is correct.**
The Smart Cities Mission is a Centrally Sponsored Scheme (Not a central sector scheme). Central Government will give financial support to the extent of Rs. 48,000 crores over 5 years, i.e. on an average of Rs.100 crore per city per year. An equal amount on a matching basis is to be provided by the State/ULB. Additional resources are to be raised through convergence, from ULBs' funds, grants under Finance Commission, innovative finance mechanisms such as Municipal Bonds, other government programs and borrowings. Emphasis has been given to the participation of the private sector through Public Private Partnerships (PPP). Citizens' aspirations were captured in the Smart City Proposals (SCPs) prepared by the selected cities. **So, Statement 2 is not correct.**
The Smart Cities Mission is under the Ministry of Housing and Urban Affairs (Not the Ministry of Rural Development). The Centre has extended the Smart Cities Mission (SCM) under the Union Urban Development Ministry till March 31, 2025. The Mission envisions developing areas within selected cities in the country as model areas based on an area development plan, which is expected to have a rub-off effect on other parts of the city and nearby cities and towns. **So, Statement 3 is not correct.**

ADDITIONAL INFORMATION:

SMART CITIES MISSION	
About	The smart city initiative aims to promote sustainable and inclusive cities that provide core infrastructure to give a decent quality of life and a clean and sustainable environment by applying smart solutions such as data-driven traffic management, intelligent lighting systems, etc.
Need for	Cities accommodate ~31% of India's current population and contribute 63% to the GDP

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the Mission	(Census 2011). ➢ By 2030, urban areas are expected to accommodate 40% of India's population and contribute 75% to the GDP. ➢ Population growth in cities leads to infrastructure management and service delivery challenges. The Smart Cities Mission in India is an initiative that aims to tackle these challenges efficiently and effectively.
The Core Elements	➢ Adequate water supply ➢ Assured electricity supply ➢ Sanitation, including solid waste management ➢ Efficient urban mobility and public transport ➢ Affordable housing, especially for the poor ➢ Robust IT connectivity and digitalization ➢ Good governance, especially e-governance and citizen participation ➢ Sustainable environment ➢ Safety and security of citizens, particularly women, children and the elderly ➢ Health and Education
Coverage	The Mission will cover 100 cities distributed among the States /Union Territories (UT) based on equitable criteria. ➢ The formula gives equal weightage (50:50) to the urban population of the State/UT and the number of statutory towns (a town with a municipality, corporation, cantonment board, or notified town area committee) in the State/UT. ➢ Based on this formula, each State/UT will have a certain number of potential Smart Cities, with each State/UT having at least one.

5. Consider the following statements :

Statement-I :

Graphite and diamond are isotopes of Carbon.

Statement-II :

Though Graphite and diamond are made of the same element, they have different physical properties and structural arrangements of atoms.

Which one of the following is correct in respect of the above statements ?

(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I

(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I

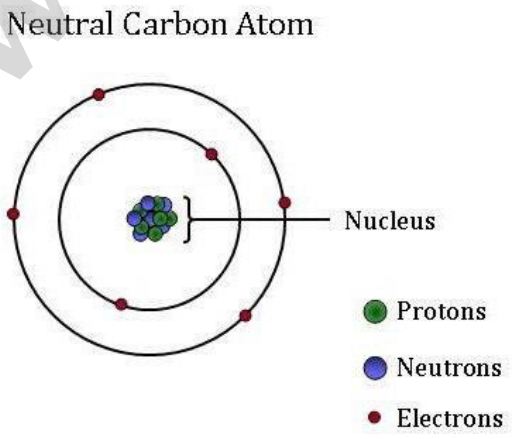
(c) Statement-I is correct, but Statement-II is incorrect

(d) Statement-I is incorrect, but Statement-II is correct

EXPLANATION:

Atoms with the same number of protons but different numbers of neutrons are called isotopes. They share almost the same chemical properties, but differ in mass and therefore in physical properties.

Graphite and diamond are allotropes of carbon (not isotropes of carbon), which means they are different structural forms of the same element, carbon. They consist of carbon atoms arranged in distinct ways, with diamond featuring a rigid three-dimensional crystal structure and graphite exhibiting a layered, planar arrangement.



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Carbon isotopes come in three forms. By far the most common isotope of carbon is carbon-

- 12 (12C), which contains six neutrons in addition to its six protons.
- The next heaviest carbon isotope, carbon-13 (13C), has seven neutrons.
- The rare carbon-14 (14C) isotope contains eight neutrons in its nucleus.

Both diamond and graphite are made entirely out of carbon, as is the more recently discovered buckminsterfullerene (a discrete soccer-ball-shaped molecule containing carbon 60 atoms). The way the carbon atoms are arranged in space, however, is different for the three materials, making them allotropes of carbon.The property of some metals and alloys that exhibit different crystalline lattices at different temperatures is called allotropy. **So, Statement 1 is not correct.**

Diamonds and graphite are both allotropes of Carbon.Allotropes are compounds of the same composition, but exists in two or more different forms due to the different bonding.

- Diamonds have a tetrahedral-like composition while graphite has a hexagonal-like arrangement layered in sheets.
- Diamonds form when the carbon atoms are bonded together in a tetrahedral-like lattice arrangement. This is the result of high temperature and pressure at the same time over a long period of time, deep in the Earth's mantle.
- Graphite however, is when the carbon atoms bond together in sheets - hexagonal-like lattice. Graphite is formed from the carbon atoms resulting from the metamorphism of minerals such as marble, quartz, etc. The arrangement of the molecules are a result of a different physical structure.

Thus the difference in physical and structural properties are due to the change in formation region. **So, Statement 2 is correct.**

ADDITIONAL INFORMATION:

CARBON NANO TUBES	
About	Carbon nanotubes (CNTs) are nanomaterials with broad applications that are produced on a large scale. Animal experiments have shown that exposure to CNTs, especially one type of multi-walled carbon nanotube, MWCNT-7.
Applications of CNT in Nanomedicine	➢ CNTs represent a promising class of nanomaterials for medical application. Researchers have demonstrated that CNTs can be used for drug and biomolecule transport , tumor imaging , and photothermal therapy. ➢ NTs are able to transport cytotoxic drugs such as doxorubicin and the prodrugs of cisplatin and paclitaxel across the cellular membrane via endocytosis.

6. Recently India's first space based mission to study the Sun, "Aditya L1" has been launched. Which of the following detectors are used by the spacecraft to study the sun ?
   1. Electromagnetic detector
   2. Particle detector
   3. Magnetic Field detector
   4. Doppler current profile detector

   Select the answer using the codes given below:

   (a) 1 and 2 only
   (b) 1, 2 and 3 only
   (c) 2, 3 and 4 only
   (d) 1, 2, 3 and 4

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EXPLANATION:

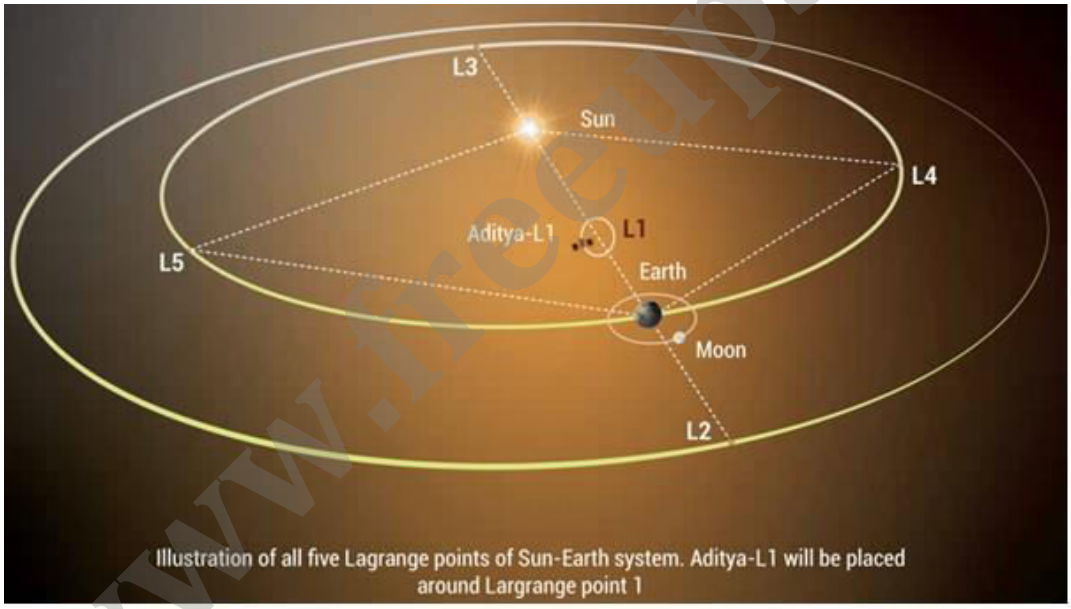
Aditya L1 is the first space-based Indian mission to study the Sun. The Indian Space Research Organisation (ISRO) has placed the Aditya-L1 spacecraft in a halo orbit around the Lagrangian point (L1), about 1.5 million km from the Earth. A satellite in the halo orbit around the L1 point has the major advantage of continuously viewing the Sun without occultation/eclipses. This will provide a greater advantage in observing solar activities and their effect on space weather in real-time.

The spacecraft carries seven payloads to observe the photosphere, chromosphere and the outermost layers of the Sun (the corona) using the following detectors.

- Electromagnetic detector
- Particle detector
- Magnetic field detectors.

An Acoustic Doppler Current Profile detector, or ADCP, is a device that uses sound waves to measure the speed and direction of currents throughout the water column. Doppler Current Profile detector is not used by the Aditya-L1 spacecraft to study the Sun. **So, Option (b) is correct.**

ADDITIONAL INFORMATION:

ADITYA L1	
About	➢ Aditya-L1, the first Indian space-based observatory to study the Sun, was launched on September 2, 2023, from the Satish Dhawan Space Centre in Sriharikota. ➢ Using the special vantage point L1, four payloads directly view the Sun, and the remaining three payloads carry out in-situ studies of particles and fields at the Lagrange point L1, thus providing important scientific studies of the propagator effect of solar dynamics in the interplanetary medium.  Illustration of all five Lagrange points of Sun-Earth system. Aditya-L1 will be placed around Largrange point 1
Payloads	➢ The Aditya L1 payloads are expected to provide the most crucial information to understand the problem of coronal heating, coronal mass ejection, pre-flare and flare activities and their characteristics, dynamics of space weather, propagation of particles and fields, etc. ➢ The instruments of Aditya-L1 are tuned to observe the solar atmosphere, mainly the chromosphere and corona. In-situ instruments will observe the local environment at L1. There are seven payloads on-board with four of them carrying out remote sensing of the Sun and three carrying in-situ observation. ➢ There are two types of payloads. They are Remote sensing payload has four payloads. They are

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	• Visible Emission Line Coronagraph (VELC) • Solar Ultraviolet Imaging Telescope (SUIT) • Solar Low Energy X-ray Spectrometer (SoLEXS) • High Energy L1 Orbiting X-ray Spectrometer(HEL1OS) In-situ payloads have three payloads. They are • Aditya Solar Wind Particle Experiment(ASPEX) • Plasma Analyser Package For Aditya (PAPA) • Advanced Tri-axial High-Resolution Digital Magnetometers
Objectives of Aditya-L1 mission	➢ Study of Solar upper atmospheric (chromosphere and corona) dynamics. ➢ Study of chromospheric and coronal heating, physics of the partially ionized plasma, initiation of the coronal mass ejections, and flares. ➢ Observe the in-situ particle and plasma environment, providing data for the study of particle dynamics from the Sun. ➢ Physics of solar corona and its heating mechanism. ➢ Diagnostics of the coronal and coronal loops plasma: Temperature, velocity and density. ➢ Development, dynamics and origin of Coronal Mass Ejections (CMEs). ➢ Identify the sequence of processes that occur at multiple layers (chromosphere, base and extended corona) which eventually leads to solar eruptive events. ➢ Magnetic field topology and magnetic field measurements in the solar corona. ➢ Drivers for space weather (origin, composition and dynamics of solar wind.

7. Consider the following :
   1. USA
   2. Russia
   3. Japan
   4. China
   5. India

   How many of the countries mentioned above have Global Navigation Satellite Systems(GNSS) ?
   (a) Only two
   (b) Only three
   (c) Only four
   (d) All five

EXPLANATION:

Global navigation satellite system (GNSS) is a general term describing any satellite constellation that provides positioning, navigation, and timing (PNT) services on a global or regional basis. Global Navigation Satellite Systems (GNSS) include constellations of Earth-orbiting satellites that broadcast their locations in space and time, networks of ground control stations, and receivers that calculate ground positions by trilateration. GNSS are used in all forms of transportation: space stations, aviation, maritime, rail, road and mass transit. Positioning, navigation and timing (PNT) play a critical role in telecommunications, land surveying, law enforcement, emergency response, precision agriculture, mining, finance, scientific research, etc. They are used to control computer networks, air traffic, power grids and more.

➢ Presently, there are four global satellite-based navigation systems.
  • United States: Global Position System (GPS)
  • Russia: Global Navigation Satellite System (GLONASS)
  • China: BeiDou Navigation Satellite System (BDS)
  • European Union: Galileo
➢ Japan has a four-satellite regional navigation system (Quasi-Zenith Satellite System).
➢ India has its own Indian Regional Navigation Satellite System- NavIC (Navigation with Indian Constellation). **So, Option (b) is correct.**

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System	GPS	GLONASS	BeiDou	Galileo	NAVIC
Owner	United States	Russian Federation	China	European Union	India
Orbital altitude	20, 180 km (12, 540 mi)	19, 130 km, (11, 890 mi)	21, 150 km, (13, 140 mi)	23,222 km , (14, 429 mi)	36, 000 km, (22,000mi)
Period	11.97 h, (11 h 58 min)	11.26 h, (11 h 16 min)	12.63 h, (12 h 38 min)	14.08 h, (14h 5min)	
Number of satellites	32 (at least 24 by design)	28 (at least 24 by design) including: 24 operational 2 under check by the satellite prime contractor 2 in flight tests phase	5 geostationary orbit (GEO) satellites, 30 medium Earth orbit (MEO) satellites	4 in-orbit validation satellites + 8 full operation capable satellites in orbit 22 operational satellites budgeted	Total: 7 In Orbit: 7
Frequency	1.57542 GHz (L1 signal) 1.2276 GHz (L2 signal)	Around 1.602 GHz (SP) Around 1.246 GHz (SP)	1.561098 GHz (B1) 1.589742GHz (B1-2) 1.20714 GHz (B2) 1.26852 GHz (B3)	1.164-1.215 GHz (E5a and E5b) 1.260-1.300 GHz (E6) 1.559-1.592 GHz (E2-L1-E11)	L5-band 1164.45-1188.45 MHz S-band 2483.5-2500 MHz
Status	Operational	Operational	22 satellites operational, 40 additional satellites 2016-2010	8 satellites operational, 22 additional satellites 2016-2020	Operational

ADDITIONAL INFORMATION:

GLOBAL NAVIGATION SATELLITE SYSTEMS (GNSS)	
GPS – USA	➢ This is the oldest system, which began operations in 1978 and grew to 32 planned satellites in Medium Earth Orbit, MEO of 20180 km. ➢ The orbits are so selected that at any given time, at least six satellites are in view of an observer anywhere on Earth.
BeiDou, or BDS	➢ BeiDou Navigation Satellite System (BDS) is a global GNSS owned and operated by the People's Republic of China. ➢ BDS was formally commissioned in 2020. The operational system consists of 35 satellites. ➢ BDS was previously called Compass.
Galileo	➢ Galileo is a global GNSS owned and operated by the European Union. ➢ The EU declared the start of Galileo Initial Services in 2016 and plans to complete the system of 24+ satellites in 2021.
GLONASS	➢ GLONASS (GlobalnayaNavigazionnayaSputnikovaya Sistema, or Global Navigation Satellite System) is a global GNSS owned and operated by the Russian Federation. ➢ The fully operational system consists of 24+ satellites.
IRNSS / NavIC	➢ IRNSS is a regional GNSS owned and operated by the Government of India. IRNSS is an autonomous system designed to cover the Indian region and 1500 km around the Indian mainland. ➢ The system consists of 7 satellites. In 2016, India renamed IRNSS as the Navigation Indian Constellation (NavIC, meaning "sailor" or "navigator").
Quasi-Zenith Satellite System (QZSS)	➢ QZSS is a regional GNSS owned by the Government of Japan and operated by QZS System Service Inc. (QSS). QZSS complements GPS to improve coverage in East Asia and Oceania. ➢ Japan declared the official start of QZSS services in 2018 with 4 operational satellites and plans to expand the constellation to 7 satellites by 2023 for autonomous capability.

8. With reference to Indian biodiversity, Indian peafowl, black kite, and Giant Grey Shrike are:
   (a) **Birds**
   (b) Reptiles
   (c) Amphibians
   (d) Primates

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EXPLANATION:

Indian peafowl, black kite, and Giant Grey Shrike are all birds.

- The Indian peafowl (Pavo cristatus), regarded as the national bird, is listed under Schedule I of the Wildlife Protection Amendment Act, 2022, with the highest degree of protection. The Indian Peafowl is found mainly on the ground in open scrub forest or on land under cultivation, where they forage for berries, grains but will also prey on snakes, lizards, and small rodents. The Indian Peafowl is listed as Least Concern by IUCN.
- The black kite species is distributed in Europe, Africa, Asia, Indian Subcontinent and Australia. The black kite species is a medium-sized bird, and the females are slightly larger than the males. The male black kite measures 45 to 65 cm in length and weighs 600 to 900 grams. The female bird weighs 750 to 1,100 grams. The wingspan is 120 to 150 cm. The black kite has dark brown plumage. The IUCN (International Union for Conservation of Nature) has categorized and evaluated these kite species and has listed them as of "Least Concern".
- Recently, a Rare Giant Shrike was spotted in Tawang for the first time in India. The giant shrike was previously recorded only in China. The giant grey shrike resembles the Chinese grey shrike in many respects, but it looks larger than the latter. A giant grey shrike has a darker back and lacks white eyebrows that are distinct in Chinese grey shrike and great grey shrike. Giant grey shrikes are found at high elevations, in open habitats with shrubs and migrate to lower elevations during winters.

So, Option (a) is correct.

Black Kite	Indian peafowl	Giant Shrike

ADDITIONAL INFORMATION:

BIRDS	
Indian Peafowl	Indian peafowl are a species in a group of birds called pheasants. The males are called peacocks, while the females are called peahens. Together, they are peafowl. Indian peafowl are native to India and Sri Lanka, in South Asia. They've been introduced to other countries, usually as exhibits in parks, zoos, and nature centres or as domestic pets. The head and body of adult peafowl range from 3 to 4 feet long, and their tail can be 5 feet long.
Black Kite	Black kite (Scientific name: Milvus migrans) is called samdi or shiyalusamdi in Gujarati. It is a medium-sized bird of prey. It is a very common bird in Ahmedabad and most big cities in India, where the population of pigeons is large – as kites hunt them. ➢ It is difficult to distinguish between a male and a female of black kites because they both look similar. ➢ The only difference is that the female is longer than a male and her wingspan is larger than that of a male. ➢ They have a dark brown body, blackish grey hooked beak, yellow colour around the nostrils, yellow gape-line and feet, and brown iris with black pupils. Its tail looks slightly forked.
Giant	A large and long-tailed shrike with dark grey upperparts, white underparts, a black mask, and

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Grey Shrike	white in the wing. ➢ The white patches in the black wings and tail are especially conspicuous in flight. Found at high elevations, in open habitats with stunted shrubs such as rhododendron. ➢ Descends to lower elevations during the winter. Often uses tall and exposed perches. Vocalizations include harsh rasping notes and more musical, liquid ones. Similar to Chinese Gray Shrike, but larger, with a darker gray back and no white eyebrow.

9. Which of the following statements is correct ?
   (a) **The speed of the sound in a medium depends on the temperature of the medium.**
   (b) The speed of sound varies for different frequencies in a given medium under the same physical conditions.
   (c) The speed of the sound in solid medium is less than the speed of the sound in gas medium at constant temperature.
   (d) All the above

EXPLANATION:

Sound is a mechanical wave and needs a material medium like air, water, steel etc. for its propagation. It cannot travel through vacuum. Sound propagates through a medium at a finite speed. The speed of sound depends on the properties of the medium through which it travels. The speed of sound in a medium depends on temperature of the medium.In any medium as we increase the temperature the speed of sound increases. The speed of sound decreases when we go from solid to gaseous state. The speed of sound is generally higher in solid and liquid media compared to gas media due to their greater rigidity and density.
So, Option (a) is correct and Option (c) is not correct.

Frequency tells us how frequently an event occurs. The sound produced with single frequency is called a tone. How the brain interprets the frequency of an emitted sound is called its pitch. The faster the vibration of the source, the higher is the frequency and the higher is the pitch. The sound which is produced due to a mixture of several frequencies is called a note and is pleasant to listen. The speed of sound remains almost the same for all frequencies in a given medium under the same physical conditions.
So, Option (b) is not correct.

ADDITIONAL INFORMATION:

SOUND	
About	➢ Sound is a form of energy which produces a sensation of hearing in our ears. ➢ We can also produce sound by plucking, scratching, rubbing, blowing or shaking different objects. When we do the above activites, We set the objects vibrating and produce sound. ➢ Vibration means a kind of rapid to and fro motion of an object. The sound of the human voice is produced due to vibrations in vocal cord.
Propagation of sound	➢ Sound is produced by vibrating objects. ➢ The matter or substance through which sound is transmitted is called a medium. It can be solid, liquid or gas. Sound moves through a medium from the point of generation to the listener. ➢ When an object vibrates, it sets the particles of the medium around it vibrating.
Characteristics	➢ Sound wave can be described by its

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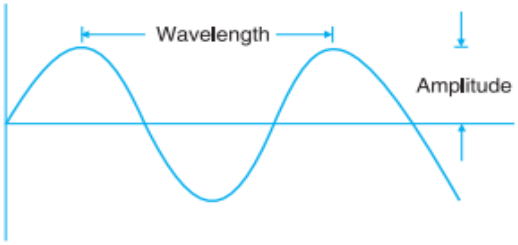
of a sound wave	• Frequency • Amplitude • Speed
Amplitude and Wavelength	➢ The (maximum) height of the wave is called amplitude. ➢ The distance between adjacent troughs or adjacent crests, measured in unit of length such as meters and expressed by symbol λ (lambda). For longitudinal wave, it will be distance between two successive rarefactions or compressions. 
Frequency	➢ The number of complete waves that pass a point in one second, measured in Hertz (Hz)

10. Consider the following statements :
    1. Unlike a free proton, a free neutron is unstable.
    2. Unlike Coulomb's law or Newton's law of gravitation, there is no simple mathematical form of the nuclear force.
    3. The nuclear force does not depend on the electric charge.

    Which of the statements given above is/are correct ?

    (a) 2 only
    (b) 1 and 2 only
    (c) 3 only
    (d) 1, 2 and 3

EXPLANATION:

The proton is a subatomic particle with a positive electrical charge. They are found in every atomic nucleus of every element. In 1932, J. Chadwick discovered another subatomic particle which had no charge and a mass nearly equal to that of a proton. It was eventually named as neutron. Neutrons are present in the nucleus of all atoms, except hydrogen.
A free neutron, unlike a free proton, is unstable. It decays into a proton, an electron and a antineutrino (another elementary particle), and has a mean life of about 1000s. It is, however, stable inside the nucleus.
So, Statement 1 is correct.

The nuclear force is the force between the particles in the nucleus of an atom. It can be between two protons, two neutrons, or between a proton and a neutron. The nuclear force is attractive. It binds the protons and neutrons together and is responsible for the stability of the nucleus. It is a short-range force with a range of the order of the proton dimension, which falls off to zero at a specific distance.
The nuclear force is much stronger than the Coulomb force acting between charges or the gravitational forces between masses. The nuclear binding force has to dominate over the Coulomb repulsive force between protons inside the nucleus. This happens only because the nuclear force is much stronger than the coulomb force. The gravitational force is much weaker than even Coulomb force.
The nuclear force between neutron-neutron, proton-neutron and proton-proton is approximately the same. The nuclear force does not depend on the electric charge. Unlike Coulomb's law or the Newton's law of gravitation there is no simple mathematical form of the nuclear force. **So, Statements 2 and 3 are correct.**

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ADDITONAL INFORMATION:

NEWTONS LAW OF MOTION	
About	Sir Isaac Newton's laws of motion explain the relationship between a physical object and the forces acting upon it. They are ➢ An object at rest remains at rest, and an object in motion remains in motion at constant speed and in a straight line unless acted on by an unbalanced force. • Newton's first law states that every object will remain at rest or in uniform motion in a straight line unless compelled to change its state by the action of an external force. • This tendency to resist changes in a state of motion is inertia. • If all the external forces cancel each other out, then there is no net force acting on the object. • If there is no net force acting on the object, then the object will maintain a constant velocity. ➢ The acceleration of an object depends on the mass of the object and the amount of force applied. • His second law defines a force to be equal to change in momentum (mass times velocity) per change in time. Momentum is defined to be the mass m of an object times its velocity V. ➢ Whenever one object exerts a force on another object, the second object exerts an equal and opposite on the first. • His third law states that for every **action** (force) in nature there is an equal and opposite **reaction**. If object A exerts a force on object B, object B also exerts an equal and opposite force on object A. In other words, forces result from interactions.

11. With reference to the Astra Mark 2 missile, consider the following statements :
    1. It is a air-to-air missile with a dual pulse solid rocket motor.
    2. It aims to target a range of over 100 km and will engage and destroy highly maneuverable supersonic aerial targets.
    3. It was designed and developed by the Defense Research and Development Laboratory (DRDL).

    Which of the above statements is/are correct ?
    (a) 1 only
    (b) 1 and 2 only
    (c) 1 and 3 only
    (d) **1, 2 and 3 only**

EXPLANATION:

ASTRA is a Beyond Visual Range (BVR) class of Air-to-Air Missile (AAM) system designed to be mounted on fighter aircraft. The missile is designed to engage and destroy highly manoeuvring supersonic aircraft.
The missile has all weather day and night capability. The missile is being developed in multiple variants to meet specific requirements. The ASTRA Mk-I Weapon System integrated with SU-30 Mk-I aircraft is being inducted into the Indian Air Force (IAF). Astra Mk-2 missile is a next-generation air-to-air missile, not a surface-to-air one, with a dual pulse solid rocket motor to strike up to 160 kilometres. **So, Statement 1 is correct.**

The Indian Air Force and DRDO have already started the process to develop Astra Mark 2, an improved version of Astra Mark 1. The Astra Mark 2 will have a head-on launch range of over 100 km along with the capability for ejector launch. The missile is designed to engage and destroy highly manoeuvring supersonic aircraft. It is certain that the Astra Mark 2 will be one of the best Beyond Visual Range (BVR) class of Air-to-Air Missile (AAM) systems capable of outperforming all current Beyond Visual Range (BVR) class of Air-to-Air Missile (AAM) systems except the European Meteor that is coming with the 36 Rafale fighters. **So, Statement 2 is correct.**

Astra Mark 2 missile is designed and developed by the Defence Research and Development Laboratory (DRDL), Research Centre Imarat (RCI) and other DRDO laboratories. The Indigenous Astra BVR firing from a homegrown Tejas fighter is a major step towards 'Aatmanirbhar Bharat'. **So, Statement 3 is correct.**

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ADDITIONAL INFORMATION:

ASTRA WEAPON SYSTEM	
About	The Astra project was officially launched in the early 2000s with defined parameters and proposed future variants. Around 2017, the development phase of the Mk-1 version was complete. The first Astra missile was launched from the Su-30MKI in May 2014. Several successful tests have been conducted since 2017 from Sukhoi-30 MKIs. ➢ While the range for Astra Mk-1 is around 110 km, the Mk-2 with a range over 150 km is under development, and the Mk-3 version with a longer range is being envisaged. ➢ One more version of Astra, with a range smaller than Mk-1, is also under development.
Astra Missiles	➢ Astra Missiles, with Beyond Visual Range capability will serve as a force multiplier and immensely add to the strike capability of the Navy and Air Force. ➢ The BVR class of Air-to-Air Missile (AAM) system is designed to be mounted on fighter aircraft. ➢ The missile has all weather day and night capability. The missile is being developed in multiple variants to meet specific requirements. ➢ The ASTRA Mk-I Weapon System integrated with SU-30 Mk-I aircraft is being inducted into the Indian Air Force (IAF). ➢ It can be launched in autonomous and buddy mode of operation with features for Lock-On-Before Launch (LOBL) and Lock-On After Launch (LOAL)."
Defence Research & Development Laboratory (DRDL)	DRDL is responsible for designing and developing state-of-the-art Missile Systems and technologies required for the country's deterrence and defence. Systems and Technologies developed by DRDL are deployed on underwater, sea, land, and air-based platforms. ➢ DRDL is working on several technologies required for the Missiles and Strategic Systems, including Aerodynamics and Airframe Design, Computational Fluid Dynamics, Solid, Liquid, Ramjet and Scramjet Propulsion, Precision Fabrication, Systems Analysis, as well as the Command and Control systems for missile-based weapon systems.

12. Recently, India protested Chinese road construction at Shaksgam Valley, which is located at :
    (a) West of Gilgit
    (b) East of Aksai chin
    (c) **North of Siachen glacier**
    (d) South of Nubra valley

EXPLANATION:

Recently, India protested against Chinese road construction at Shaksgam Valley in Pakistan-occupied Kashmir (PoK). The Shaksgam Valley, or the Trans Karakoram Tract, is part of the Hunza-Gilgit Region of PoK. Shaksgam Valley is located north of the Siachen glacier, north of Baltistan, east of Gilgit and south of the Chinese province of Xinjiang. **So, Option (c) is correct.**

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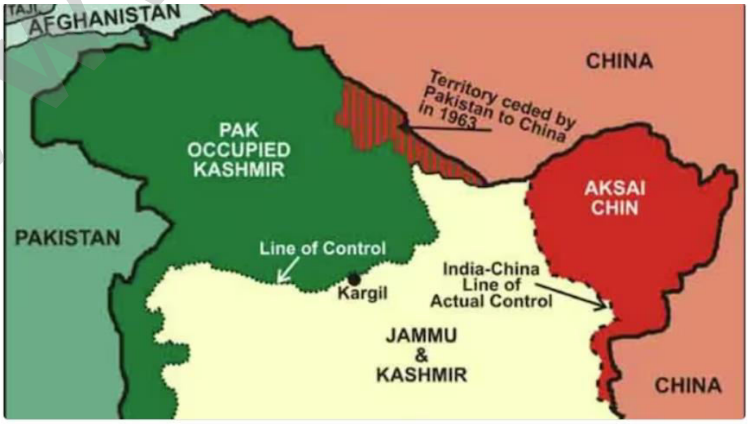
ADDITIONAL INFORMATION:

FRONTIER REGIONS OF JAMMU AND KASHMIR	
Recently in news	The Indian Army is set to analyze the military implications of China's construction of a road in the Shaksgam Valley. This move comes amidst concerns that Beijing's physical occupation in the region could potentially threaten Indian defences in the Siachen Glacier area. The 5180 square kilometres of Indian territory in the Shaksgam Valley was illegally ceded by Pakistan to China in 1963.
Gilgit-Baltistan	Situated on the northwestern corner of Jammu and Kashmir, Gilgit Baltistan was erstwhile a part of the princely state of Jammu and Kashmir. Gilgit Baltistan Map
Aksai Chin	Aksai Chin is almost the size of Bhutan and a little smaller than Switzerland. Most of it is in the occupation of China, which captured the region during the 1950s and consolidated its military grip over the area during the 1962 India-China war, rejecting all Indian attempts to settle border disputes peacefully.  *Map of India showing Aksai Chin that was illegally occupied by China during 1950s and consolidated in 1962 war.*

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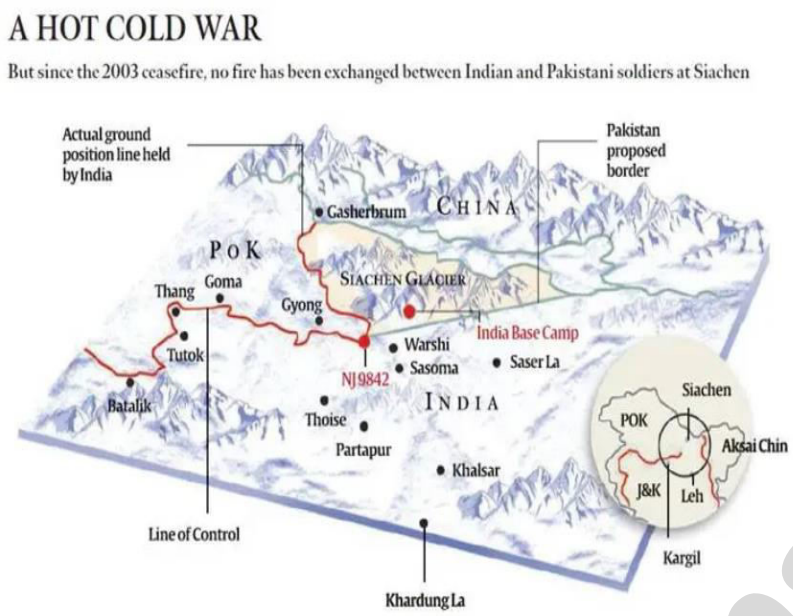
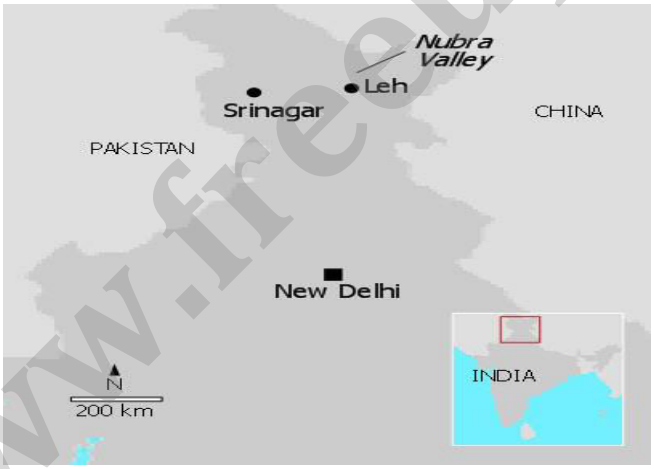
Siachen Glacier	Siachen Glacier, the world's second-longest glacier in non-polar areas, lies in the Karakoram Range of the Himalayas in the disputed Kashmir region. ➢ The glacier covers 76 km from its head at Indira Col on the China-India border to its terminus, with its altitude falling from 5,753m to 3,620m above sea level. ➢ The Siachen Glacier is bordered to the north by the great drainage divide, a divide separating the Indian Subcontinent and the Eurasian Plate in the Karakoram region. 
Nubra valley	Nubra Valley is located in the northernmost part of Ladakh, India. It lies between the Karakoram and Ladakh mountain ranges, about 150 kilometres north of Leh. 

13. Consider the following statements :
    1. It consists of long chain molecules aligned in a particular direction.
    2. It works on the principle of Malus' law in physics.
    3. It can be used to control the intensity, sunglasses and windowpanes
    4. They are used in photographic cameras and 3D movie cameras.

    The above statements refer to which of the following ?
    (a) Prism
    (b) Polaroids
    (c) Optical fibres
    (d) Diffraction slit

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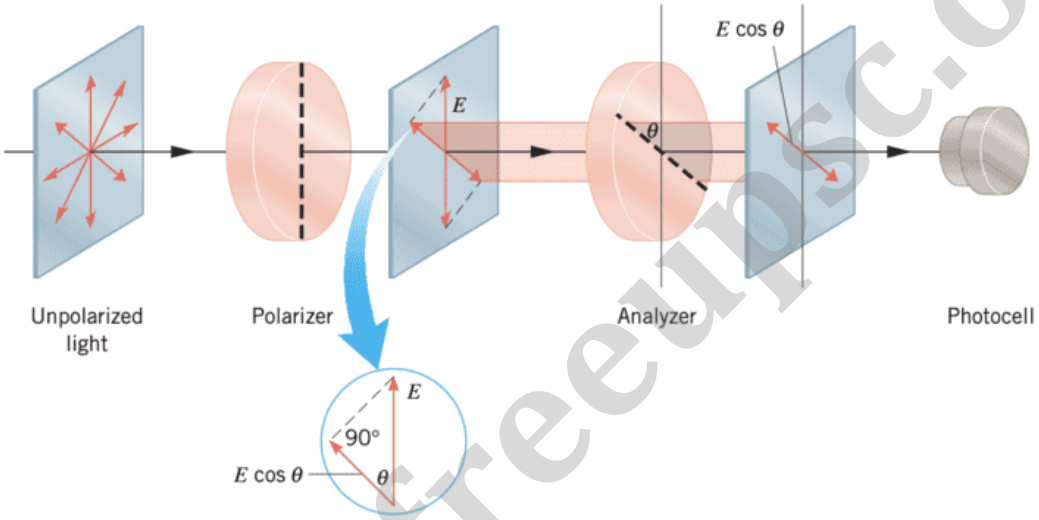
EXPLANATION:

Light waves are transverse in nature; i.e., the electric field associated with a propagating light wave is always at right angles to the direction of propagation of the wave. This can be easily demonstrated using a simple Polaroid, which are called polaroids.

- A Polaroid consists of long chain molecules aligned in a particular direction. The electric vectors (associated with the propagating light wave) along the direction of the aligned molecules get absorbed.
- When light falls on a polarizer, the transmitted light gets polarized. The polarized light falling on another Polaroid, called analyzer, transmits light depending on the orientation of its axis with the polarizer. The intensity of light transmitted through the analyzer is given by Malus' law. The law describes how the intensity of light transmitted by the analyzer varies with the angle that its plane of transmission makes with that of the polarizer. $I = I_o \cos^2(q)$. Where Io is the intensity of the polarized light after passing through 1st Polaroid sheet. So, Polaroid works on the principle of Malus' law.
- The intensity coming out of a single polaroid is half of the incident intensity. By putting a second Polaroid, the intensity can be further controlled from 50% to zero of the incident intensity by adjusting the angle between the pass-axes of two polaroids. So, Polaroids can be used to control the intensity, in sunglasses, windowpanes, etc. Polaroids are also used in photographic cameras and 3D movie cameras. **So, Option (b) is correct.**



ADDITIONAL INFORMATION:

DIFFRACTION OF LIGHT	
About	➢ Bending of light around the obstacle is known as diffraction. To observe diffraction, either of the following conditions must be satisfied: • The size of the obstacle or the aperture should be of the order of the wavelength of the incident wave. • The separation between the obstacle or aperture and the screen should be considerably larger (a few thousand times) than the size of the obstacle or aperture.
Prism	➢ Prism, in optics, a piece of glass or other transparent material cut with precise angles and plane faces, useful for analyzing and reflecting light. ➢ An ordinary triangular prism can separate white light into its constituent colours, called a spectrum. ➢ Each colour, or wavelength, making up the white light is bent, or refracted, a different amount; the shorter wavelengths (those toward the violet end of the spectrum) are bent the most, and the longer wavelengths (those toward the red end of the spectrum) are bent the least. ➢ Prisms can reverse the direction of light by internal reflection, and for this purpose they are useful in binoculars.

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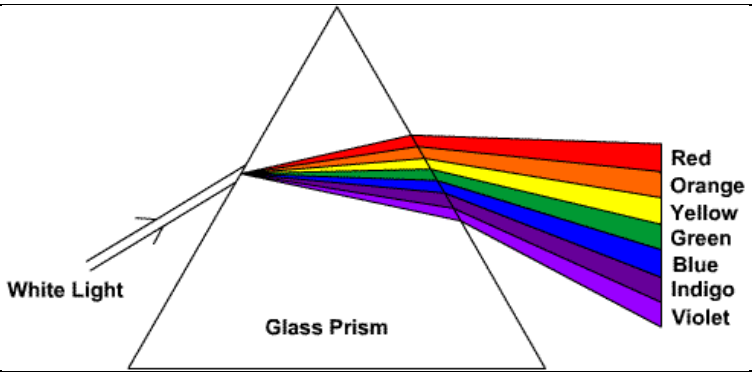
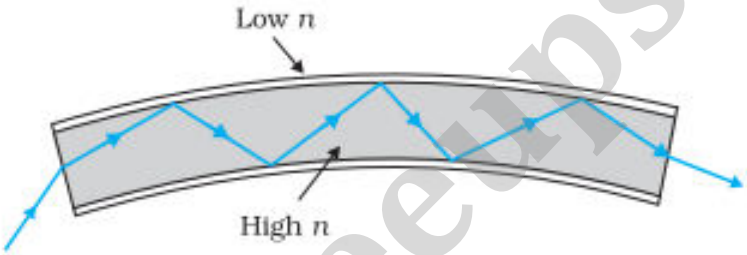


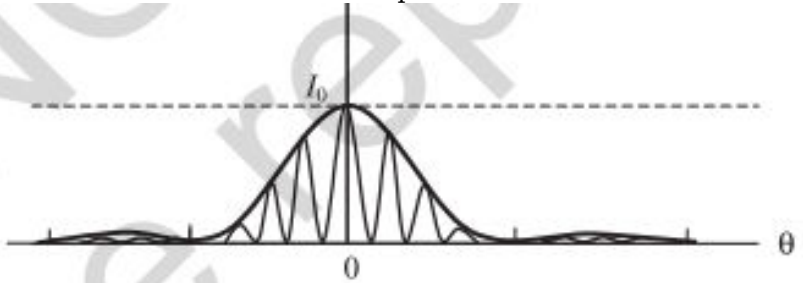
Optical fibres

- Now-a-days optical fibres are extensively used for transmitting audio and video signals through long distances.
- Optical fibres too make use of the phenomenon of total internal reflection. Optical fibres are fabricated with high quality composite glass/quartz fibres.
- Each fibre consists of a core and cladding. The refractive index of the material of the core is higher than that of the cladding.
- Light is transmitted along the center of the fiber from one end to the other, and a signal may be imposed.
- It works on the principle of Snell's law in physics: $n_I \sin I = n_R \sin R$
- **Snell's law**, in optics, a relationship between the path taken by a ray of light in crossing the boundary or surface of separation between two contacting substances and the refractive index of each.



Diffraction slit

- Diffraction is the spreading out of waves as they pass through an aperture or around objects.
- It occurs when the size of the aperture or obstacle is of the same order of magnitude as the wavelength of the incident wave.
- The diffraction pattern made by waves passing through a slit of width a (larger than λ) can be understood by imagining a series of point sources all in phase along the width of the slit.
- The waves moving directly forward are all in phase (they have zero path difference), so they form a large central maximum.
- It works on the principle of Huygen's Principle: Huygens argued that a wavefront could be modelled as a series of wavelets. A wavelet can be described as a circular wave much like the ripple you would get from dropping a small pebble into a pond. These wavelets superimpose and interfere to form more complicated wavefronts.



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14. Consider the following statements with respect to Free Space Optical Communication :
    1. It uses light propagating in free space to wirelessly transmit data for telecommunications.
    2. It utilises the infrared band of spectrum for data transmission.
    3. It can be used to transmit data between two points which have a direct line of sight.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

EXPLANATION:

Free Space Optical Communication (FSO) also known as fibre-free or fiberless photonics, is a wireless technology that utilizes light propagating through free space (air, outer space, vacuum, or similar mediums) to transmit data for telecommunications and computer networking.
It is a technology that transports data via laser technology. Laser beams are generally used, although non-lasing sources such as light-emitting diodes (LEDs) or IR-emitting diodes (IREDs) will serve the same purpose. FSO can be the best wireless solution where fibre optical cable is not available; high bandwidth (anywhere from 1 Mbps up to 1.25 Gbps) is required. **So, Statement 1 is correct.**

The carrier used to transmit Free Space Optical (FSO) communication signal is Infrared and is generated by either high power LED or laser diode.
FSO systems can function over distances of several hundred meters up to 4 km, depending on system characteristics and environmental conditions. As long as there is a clear line of sight (LOS) between the source and the destination, communication is theoretically possible. Even if there is no direct line of sight, strategically positioned mirrors can be used to reflect the energy. The beams can pass through glass windows with little or no attenuation. **So, Statements 2 and 3 are correct.**

ADDITIONAL INFORMATION:

FREE SPACE OPTICS (FSO) COMMUNICATION	
About	➢ Fibre-optic cable and FSO Communication share some similarities. The theory of FSO is essentially the same as that of fibre optic transmission. The use of lasers is a simple concept similar to optical transmissions using fibre-optic cables. ➢ Transmission using FSO technology is relatively simple. It involves two systems, each comprising an optical transceiver, consisting of a laser transmitter and a receiver to provide full duplex (bi-directional) capability. ➢ FSO uses low-power lasers and a telescope to transmit single or multiple wavelengths through the air to a receiver. FSO system uses a high-power optical source such as a laser or LED and a telescope that transmits light through the atmosphere to another telescope that receives the information. At that point, the receiving telescope connects to a high-sensitivity receiver through an optical fibre. At the source, the visible or IR energy is modulated with the data to be transmitted. At the destination, the beam is intercepted by a photodetector, the data is extracted from the visible or IR beam (demodulated), and the resulting signal is amplified and sent to the hardware.

15. Consider the following :
    1. Android
    2. Linux
    3. Mozilla Firefox
    4. VLC media player
    5. Python

    How many of the software mentioned above belong to the category of Open-source software (OSS) ?
    (a) Only two
    (b) Only three
    (c) Only four
    (d) All five

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EXPLANATION:

Open source software is software developed and maintained through open collaboration. It is made available for anyone to use, examine, alter and redistribute however they like, typically at no cost. Android is an open source operating system for mobile devices and a corresponding open source project led by Google. This site and the Android Open Source Project (AOSP) repository offer the information and source code needed to create custom variants of the Android OS, port devices and accessories to the Android platform, and ensure devices meet the compatibility requirements that keep the Android ecosystem a healthy and stable environment for millions of users. **So, Statement 1 is correct.**
Linux is the best-known and most-used open source operating system. As an operating system, Linux is software that sits underneath all of the other software on a computer, receiving requests from those programs and relaying these requests to the computer's hardware. In many ways, Linux is similar to other operating systems such as Windows, macOS (formerly OS X), or iOS. Like other operating systems, Linux has a graphical interface, and the same types of software such as word processors, photo editors, video editors, and so on. **So, Statement 2 is correct.**
Mozilla Firefox is free and open source software, built by a community of thousands from all over the world. It's an excellent web browser with nothing to hide. It's got no ulterior motive aside from keeping the web open, educating people about the Internet, and promoting open source solutions to everyday tasks. **So, Statement 3 is correct.**
VLC media player is a free and open source cross-platform multimedia player and framework that plays most multimedia files as well as DVDs, Audio CDs, VCDs, and various streaming protocols. VLC has the most complete feature-set over the video, subtitle synchronisation, video and audio filters. VLC has hardware decoding on most platforms. **So, Statement 4 is correct.**
Python is developed under an OSI-approved open source license, making it freely usable and distributable, even for commercial use. Python's license is administered by the Python Software Foundation. Python can be easy to pick up for a first time programmer or experienced with other languages. The mission of the Python Software Foundation is to promote, protect, and advance the Python programming language, and to support and facilitate the growth of a diverse and international community of Python programmers. **So, Statement 5 is correct.**

ADDITIONAL INFORMATION:

OPEN SOURCE SOFTWARE	
About	➢ Open source software now plays a vital role in computing, with open source technologies providing the foundation of the internet, business computing and personal computing. ➢ Virtually all computing devices now contain open source code of many types, typically adopted by developers to perform fundamental operations, and often more advanced functions. ➢ Open source contrasts with proprietary or closed-source software applications. The creator or copyright holder sells the proprietary or closed source software to end users, who are not allowed to edit, enhance or redistribute the product except as specified by the copyright holder. ➢ The term "open source" also refers more generally to a community-based approach to creating any intellectual property, such as software, through open collaboration, inclusiveness, transparency and frequent public updates. ➢ Some of the most prevalent open source software applications include: • The Linux® operating system, an open source alternative to the UNIX operating system. • Mozilla Firefox, a web browser originally based on Netscape Navigator • LibreOffice, a suite of office productivity apps that rival Microsoft Office • GIMP (GNU Image Manipulation Program), an open source alternative to Adobe Photoshop • VLC Media Player, a cross-platform app for viewing videos

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Closed source software	➢ Closed source software operates on a similar principle. The software's source code is proprietary, and its development is controlled by an individual or a company. Users can purchase or license the software to use it, but they cannot see how it's built or make any modifications to it. ➢ Some well-known examples of closed source software include: • Microsoft Windows: computer operating system (OS) developed by Microsoft Corporation to run personal computers (PCs). • Adobe Photoshop: computer application software used to edit and manipulate digital images. • Apple iOS: iOS is a mobile operating system developed by Apple exclusively for its Smartphone's. • Zoom: software for video communication over the Internet. • UNIX: is a multiuser, multitasking operating system (OS) designed for flexibility and adaptability. UNIX was one of the first OS to be written in the C programming language.

16. Consider the following countries :
    1. Canada
    2. France
    3. India
    4. Russia
    5. Japan
    6. United States

    Which of the above countries are part of the G7 grouping countries ?
    (a) 1, 2, 3 and 4
    (b) 2, 3, 4 and 5
    (c) **1, 2, 5 and 6**
    (d) 1, 3, 5 and 6

EXPLANATION:

The G7 is an informal bloc of industrialized democracies—the United States, Canada, France, Germany, Italy, Japan, and the United Kingdom (UK)—that meets annually to discuss issues such as global economic governance, international security, and, most recently, artificial intelligence (AI).

- The United States, France, Italy, Japan, the UK, and West Germany formed the Group of Six in 1975 to provide a venue for noncommunist powers to address pressing economic concerns, which included inflation and a recession sparked by the Organization of the Petroleum Exporting Countries (OPEC) oil embargo. Canada joined the following year, and Cold War politics invariably entered the group's agenda.
- The European Union (EU) has participated fully in the G7 since 1981 as a "non-enumerated" member.
- Russia belonged to the forum from 1998 through 2014, when the bloc was known as the Group of Eight (G8), but the country was suspended following its annexation of Ukraine's Crimea region and formed as G7 grouping countries.
- Three of the world's top 10 economies, China, India and Brazil are not included in the G7 grouping countries.

Here, Canada, France, Japan and United States are part of G7 and Russia and India is not a part in G7 countries. **So, Option (c) is correct.**

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ADDITIONAL INFORMATION:

G7 GROUPING COUNTRIES	
Recently in News	The G7 will mark its 50th anniversary this year when Italy hosts the Summit on June 2024 in Apulia, southern Italy.
About	➢ The G-7 is not an official, formal entity and, therefore, has no legislative or authoritative power to enforce the recommended policies and plans it compiles. ➢ The major purpose of the G-7 is to discuss and sometimes act in concert to help resolve global problems, with a special focus on economic issues. Since its inception in the early 1970s, the group has discussed financial crises, monetary systems, and major world crises, such as oil shortages. ➢ The host of the G7 summit, also known as the presidency, rotates annually among member countries ➢ The G-7 has also launched initiatives to fund issues and relieve crises where it sees an opportunity for joint action. Those efforts include several aimed at debt relief for developing nations.
G7 Summit 2024	The following are the Agenda from the G7 summit 2024: ➢ **Diversifying and de-risking partnerships:** China is a major factor in the G7's emphasis on deepening partnerships with emerging economies and developing states. ➢ **Widening development agenda:** • The effects of the COVID-19 pandemic, the growing climate crisis, and the ongoing war in Ukraine has diverted attention away from broader development objectives and strained commitments from traditional international donors. • This had increased the G7's attention on the development agenda in recent years, compounded by its need for diversification in global supply chains. ➢ **Climate change:** • The G7 has linked it's just energy transitions and decarbonisation interests with its de-risking strategy by positioning members states as preferred partners and donors for developing states through initiatives such as: the Build Back Better

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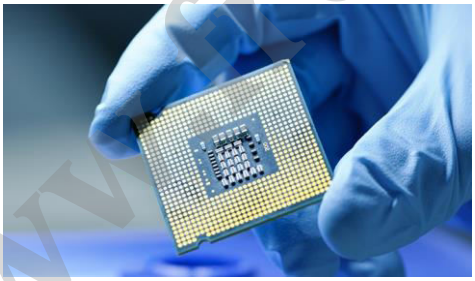
	World (B3W) initiative; and the Partnership for Global Infrastructure and Investment (PGII). • Decarbonisation has been underpinned by the G7's interest in moving away from its dependency on Russia. • Italy will also include Africa in the climate change conversation by focusing on its green energy potentials. ➢ **Artificial Intelligence (AI):** • Italy is concerned with the risks of AI posed to privacy, freedom of speech, and job security. • While many regional and national actors are working on regulation regarding AI such as the UNESCO, and the EU, the G7 aims to shape this space by building on the Hiroshima AI Process with a toolkit that will further establish ethical rules for the design, development, and branding of algorithms. ➢ **Strengthening the rules based international system:** Tensions between major powers of China and the US, and the West and Russia, have marked international relations in recent years, which has undermined collective action on pressing existential issues and hindered recovery coming out of the global pandemic.

17. "Photolithographic technology", recently seen in news is related to which of the following ?
(a) **Production of semiconductors**
(b) Protein synthesis prediction
(c) Bio 3D printing
(d) Remote sensing technology

EXPLANATION:

Photolithography, or optical or UV lithography, is a microfabrication technique employed to pattern parts of a thin film or bulk of a substrate. The desired geometrical pattern is created on a photomask. This pattern is transferred from the photomask onto a light sensitive material, often termed as photoresist of resist on a substrate. Further chemical treatments are done to engrave the exposed pattern on the substrate. Additionally, a new material can also be deposited in the desired pattern under the photoresist. This technique is widely used in semiconductor industries to produce modern CMOS devices. **So, Option (a) is correct.**



ADDITIONAL INFORMATION:

PHOTOLITHOGRAPHIC TECHNOLOGY	
Working Procedure	The photolithography process involves multiple sequential steps which can be summarised as follows: ➢ **Cleaning:** It is the first step in the photolithography process and involves removal of both organic and inorganic contaminants that might be present on the wafer surface. ➢ **Preparation:** The wafer is heated to about 150 °C for about 10 minutes to remove any moisture present on the wafer surface. ➢ **Appliying Photoresist:** Photoresist can be applied on the wafer surface by spin coating.

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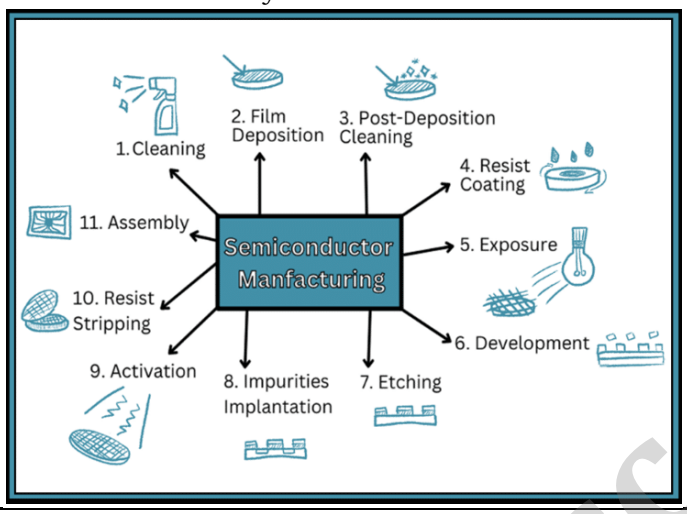
	➢ **Exposure and Development:** After prebaking, the resist is subjected to light exposure. ➢ **Etching:** Both wet or dry etching can be performed. Semiconductor manufacturing uses dry etching, because it can be made anisotropic, thereby avoiding considerable undercutting of the photoresist patterns. ➢ **Photoresist Removal:** An aqueous 'resist stripper' can alter the resist such that it does not adhere to the surface anymore. 
Uses of Semiconductor	Semiconductors fall into four main product categories: ➢ **Memory:** Memory chips serve as temporary storehouses of data and pass information to and from computer devices' brains. ➢ **Microprocessors:** These are central processing units that contain the basic logic to perform tasks. ➢ **Commodity Integrated Circuit:** Sometimes called "standard chips", these are produced in huge batches for routine processing purposes. ➢ **Complex SOC:** "System on a Chip" is essentially all about the creation of an integrated circuit chip with an entire system's capability on it.

18. Consider the following :
    1. Prithivi II missile
    2. Agni IV missile
    3. DHANUSH missile
    4. BRAHMOS missile

    Which of the above-mentioned are Ballistic Missile that are currently operational in the Indian Defence Force ?

    (a) 1 only
    (b) **1 and 2 only**
    (c) 2 and 3 only
    (d) 3 and 4 only

EXPLANATION:

Indian Army successfully launched a Prithvi-II short range ballistic missile (SRBM). "A well-established system, Prithvi-II missile has been an integral part of India's nuclear deterrence. The missile struck its target with high accuracy. The missile, which is powered by light propulsion twin engines, has a range of around 350 km and can carry 500-1,000 kg of warheads. It uses an advanced inertial navigation system to strike the set target. Prithvi-II, first tested in 1996, was inducted into Indian armed forces in 2003, and is one of the many missiles developed by the Defence Research and Development Organisation (DRDO) under the Integrated Guided Missile Development Program (IGMDP). Recently India conductes a

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successful night user trial of its nuclear-capable Prithvi-II missile from a defence facility off the coast of Odisha. **So, Statement 1 is correct.**
Agni-4 Intermediate Range Ballistic Missile-The Agni-4 is a long-range, surface-to-surface bllistic missile with a range of 4,000 kilometres , capable of carrying nuclear warheads. This missile featured an enlarged first stage motor, an upgraded second stage motor, improved guidance and electronics, and new thrust vector control systems compared to the original Agni-II. In September 2024, India has carried out a successful launch of an Intermediate Range Ballistic Missile, Agni-4, from the Integrated Test Range at Chandipur in Odisha. The Defence Ministry said the launch successfully validated all operational and technical parameters. It was conducted under the aegis of the Strategic Forces Command. The launch marks another milestone in strengthening India's defence capabilities. **So, Statement 2 is correct**
The Dhanush missile is an Indian short-range, ship-launched ballistic missile (ShLBM). It is the third variant of the Prithvi missile family, which includes the Prithvi I, Prithvi II, and the Prithivi Air Defense interceptor. It is probably liquid fueled, capable of carry nuclear or conventional payloads. The range is estimated in between 150 and 400 km, with an accuracy of 50 m CEP. Though Dhanush is ballistic missile, Recently, India retires from Nuclear Capable Dhanush Missile system. (So, it is not currently operational). **So, Statement 3 is not correct.**
The BrahMos (PJ-10) is a short-range, ramjet powered, single warhead, supersonic anti-ship/land attack cruise missile developed and manufactured by India and Russia. The BrahMos has a range of between 300-500 km depending on which variant and launch platform is used. The missile is powered by a solid propellant boost motor with a liquid-fueled ramjet sustainer motor. BrahMos missile are still in operation also India Export to other countries. Recently India delivered the first batch of BrahMos supersonic cruise missiles to Philippines**.** Here BrahMos is a Cruise missile not a Ballistic missile. **So, Statement 4 is not correct.**

ADDITIONAL INFORMATION:

BALLISTIC MISSILES	
About	There are four general classifications of ballistic missiles based on their range, or the maximum distance the missile can travel: • Short-range: less than 1,000 kilometers (approximately 620 miles), also known as "tactical" ballistic missiles. • Medium-range: between 1,000 and 3,000 kilometers (approximately 620-1,860 miles), also known as "theater" ballistic missiles. • Intermediate-range: between 3,000 and 5,500 kilometers (approximately 1,860-3,410 miles) • Long-range: more than 5,500 kilometers (approximately 3,410 miles), also known as intercontinental or strategic ballistic missiles. Intercontinental ballistic missiles (ICBMs) can fly much further than the minimum range; for example, Russia could hit Chicago with an ICBM launched from the Krasnoyarsk ICBM base, which is located 9,156 kilometers (5,689miles) away.
Stages of flight	Ballistic missiles have three stages of flight ➢ Boost Phase begins at launch and lasts until the rocket engine(s) stops firing and the missile begins unpowered flight. Depending on the missile, boost phase can last three to five minutes. Most of this phase takes place in the tmosphere. ➢ Midcourse Phase begins after the rocket(s) stops firing. The missile continues to ascend toward the highest point in its trajectory, and then begins to descend toward Earth. This is the longest phase of a missile's flight; for ICBMs, it can last around 20 minutes. During midcourse phase, ICBMs can travel around 24,000 kilometers per hour (15,000 miles per hour). ➢ Terminal Phase begins when the detached warhead(s) reenter the Earth's

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	atmosphere and ends upon impact or detonation. During this phase, which can last for less than a minute, strategic warheads can be traveling at speeds greater than 3,200 kilometers per hour (1,988 miles per hour).

19. Consider the following statements:
    1. Higher concentrations of this pollutant damage the leaves of plants and retard the rate of photosynthesis.
    2. It is a lung irritant that can lead to an acute respiratory disease in children.
    3. It is harmful to various textile fibres and metals.
    4. It is a secondary pollutant which is toxic to living tissues.

    The above statements refer to which of the following pollutants ?

    (a) Carbon dioxide
    (b) Nitrogen dioxide
    (c) Volatile organic compounds
    (d) Sulphur oxide

EXPLANATION:

Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. A substance, which causes pollution, is known as pollutant. Pollutants can be solid, liquid or gaseous substances present in greater concentration than in natural abundance and are produced due to human activities or due to natural happenings.

For example: In an automobile engine, (at high temperature) when fossil fuel is burnt, dinitrogen and dioxygen combine to yield significant quantities of nitric oxide (NO) and nitrogen dioxide (NO2).

Higher concentrations of NO2 damage the leaves of plants and retard the rate of photosynthesis. Nitrogen dioxide is a lung irritant that can lead to an acute respiratory disease in children. It is toxic to living tissues also. Nitrogen dioxide is also harmful to various textile fibres and metals.

Carbon dioxide (CO_2): While carbon dioxide is a greenhouse gas and contributes to climate change, it is not toxic in the concentrations typically found in the atmosphere and it is not secondary pollutant.

Volatile organic compounds (VOCs): VOCs are a group of chemicals that can contribute to the formation of ground-level ozone, a secondary pollutant, but VOCs themselves aren't directly toxic in the same way NO_2 is.

Sulphur oxide (SOx): Sulfur oxides can be toxic and cause respiratory problems, but they are primary pollutants, not secondary ones. **So, Option (b) is correct**.

ADDITIONAL INFORMATION:

POLLUTANTS	
Sulphur dioxide	➢ Oxides of sulphur are produced when sulphur containing fossil fuel is burnt. ➢ The most common species, sulphur dioxide, is a gas that is poisonous to both animals and plants. ➢ It has been reported that even a low concentration of sulphur dioxide causes respiratory diseases e.g., asthma, bronchitis, emphysema in human beings. ➢ Sulphur dioxide causes irritation to the eyes, resulting in tears and redness. ➢ High concentration of SO2 leads to stiffness of flower buds which eventually fall off from plants.
Hydrocarbons	➢ Hydrocarbons are composed of hydrogen and carbon only and are formed by incomplete combustion of fuel used in automobiles. ➢ Hydrocarbons are carcinogenic, i.e., they cause cancer. ➢ They harm plants by causing ageing, breakdown of tissues and shedding of leaves, flowers and twigs.
Carbon monoxide	➢ Carbon monoxide (CO) is one of the most serious air pollutants. It is a colourless and odourless gas, highly poisonous to living beings because of its ability to block the

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	delivery of oxygen to the organs and tissues. ➢ Why carbon monoxide is poisonous? • It binds to haemoglobin to form carboxyhaemoglobin, which is about 300 times more stable than the oxygen-haemoglobin complex. In blood, when the concentration of carboxyhaemoglobin reaches about 3–4 per cent, the oxygen carrying capacity of blood is greatly reduced. This oxygen deficiency, results into headache, weak eyesight, nervousness and cardiovascular disorder. This is the reason why people are advised not to smoke. In pregnant women who have the habit of smoking the increased CO level in blood may induce premature birth, spontaneous abortions and deformed babies.

20. Consider the following statements regarding Diplomatic passports :
    1. Like normal passports, diplomatic passports are valid for 10 years.
    2. Diplomatic passports are also provided to relatives and immediate families of officers employed in the Indian Foreign Service (IFS).
    3. Holders of diplomatic passports are entitled to certain privileges and immunities as per international law.

    Which of the statements given above is/are correct ?
    (a) 2 only
    (b) 1 and 2 only
    (c) 3 only
    (d) **2 and 3 only**

EXPLANATION:

An ordinary passport (Type P) is navy blue and is issued to regular Indian citizens travelling for business or leisure. It typically has 30 to 60 pages and is valid for five years for minors and ten years for adults. A diplomatic passport (Type D) is maroon, has 28 pages, and is issued for up to 5 years to government representatives and diplomats travelling on official business.

Holders of diplomatic passports are entitled to certain privileges and immunities as per international law, including immunity from arrest, detention, and certain legal proceedings in the host country. **So, Statement 1 is not correct, and Statement 3 is correct.**

The Ministry of External Affairs (MEA) Consular, Passport & Visa Division issues diplomatic passports ('Type D' passports) to people falling in broadly five categories:

- ➢ Those with diplomatic status.
- ➢ Government-appointed individuals travelling abroad for official business.
- ➢ Officers working under the branches A and B of the Indian Foreign Service (IFS), normally at the rank of Joint Secretary and above; and relatives and immediate family of officers employed in IFS and MEA.

So, Statement 2 is correct.

ADDITIONAL INFORMATION:

DIPLOMATIC PASSPORTS IN INDIA	
Currently in News	India Moldova sign pact on visa waiver on diplomatic and official passports.
About	Specific people with diplomatic titles who travel abroad to conduct official business are granted diplomatic passports in India. These passports are Type D, and they stand out from regular passports in a big way. Diplomatic passport covers are maroon rather than the standard dark blue.

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<table>
<tr><td></td><td>
</td></tr>
<tr><td>Benefits</td><td>The holders of diplomatic or official passports are accorded a unique status. They have a trouble-free international travel experience. These are a few of the main advantages of having a diplomatic passport that you should be aware of –
Special consideration upon arrival in the foreign country
Specific considerations when travelling and distinct airport channels
Less expensive or requires no visa fees
There are no delays because passenger inspections take a long time during boarding.
Questions concerning immigration are not a concern.</td></tr>
<tr><td>Ordinary Passport Vs. Diplomatic Passport</td><td>The differences between an ordinary passport and a diplomatic passport are mentioned in the table below:
<table>
<tr><th>Ordinary Passport</th><th>Diplomatic Passport</th></tr>
<tr><td>The ordinary passport, referred to as passport type P, is given to regular Indian citizens who are travelling abroad for professional or leisure purposes.</td><td>Government representatives and diplomats who travel abroad are issued a diplomatic passport.</td></tr>
<tr><td>It is navy blue in colour.</td><td>It is maroon in colour.</td></tr>
<tr><td>An ordinary passport has 30 to 60 pages.</td><td>A diplomatic passport comes with 28 pages.</td></tr>
<tr><td>An ordinary passport is valid for 10 years in the case of adults and 5 years in the case of minors.</td><td>Diplomatic passports are issued for a period of five years or less.</td></tr>
<tr><td>It is issued to individuals visiting a foreign country for business or vacation.</td><td>It is used by high-ranking government employees to travel abroad on official business.</td></tr>
</table></td></tr>
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21. Consider the following statements with reference to mass and energy **:**
    1. Both matter and energy can neither be created nor destroyed.
    2. Though energy can be transformed from one form to another, the total energy of an isolated system remains constant.
    3. Though the principle of conservation of energy cannot be proved, no violations have ever been observed.

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

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EXPLANATION:

The Law of Conservation of Mass states that mass is neither created nor destroyed in chemical reactions. In other words, the mass of any one element at the beginning of a reaction will equal the mass of that element at the end of the reaction. Matter might change its phase, e.g. glacial ice could melt into a gushing stream, but matter is neither created nor destroyed;

Albert Einstein (1879-1955) however, showed that mass and energy are equivalent and are related by the relation: the increased relativistic mass (m) of a body times the speed of light squared (c^2) is equal to the kinetic energy (E) of that body.

$$\mathbf{E = mc^2}$$

The first law of thermodynamics or the law of conservation of energy. The change in a system's internal energy is equal to the difference between heat added to the system from its surroundings and work done by the system on its surroundings. In other words, energy cannot be created or destroyed but merely converted from one form to another. **So Statement 1 is correct**

If some of the forces involved are non-conservative, part of the mechanical energy may get transformed into other forms such as heat, light and sound. However, the total energy of an isolated system does not change, as long as one accounts for all forms of energy. Energy may be transformed from one form to another but the total energy of an isolated system remains constant. **So, Statement 2 is correct.**

The principle of conservation of energy cannot be proved. However, no violation of this principle has been observed. The concept of conservation and transformation of energy into various forms links together various branches of physics, chemistry and life sciences. It provides a unifying, enduring element in our scientific pursuits. From engineering point of view all electronic, communication and mechanical devices rely on some forms of energy transformation. **So, Statement 3 is correct.**

ADDITIONAL INFORMATION:

CONSERVATION LAW	
About	**Conservation law**, in physics, a principle that states that a certain physical property (i.e., a measurable quantity) does not change in the course of time within an isolated physical system. In classical physics, laws of this type govern Energy, Linear momentum, Angular momentum, Mass, and Electric charge. ➢ **Conservation of energy**: • Principle of physics according to which the energy of interacting bodies or particles in a closed system remains constant. • The first kind of energy to be recognized was kinetic energy, or energy of motion. • In certain particle collisions, called elastic, the sum of the kinetic energy of the particles before collision is equal to the sum of the kinetic energy of the particles after collision. ➢ Conservation of mass: • It implies that matter can be neither created nor destroyed—i.e., processes that change the physical or chemical properties of substances within an isolated system (such as conversion of a liquid to a gas) leave the total mass unchanged. • Strictly speaking, mass is not a conserved quantity. However, except in nuclear reactions, the conversion of rest mass into other forms of mass-energy is so small that, to a high degree of precision, rest mass may be thought of as conserved. • Both the laws of conservation of mass and conservation of energy can be combined into one law, the conservation of mass-energy. ➢ **Conservation of momentum**: • General Law of physics according to which the quantity called momentum that characterizes motion never changes in an isolated collection of objects, that is, the total momentum of a system remains constant. • Momentum is equal to the mass of an object multiplied by its velocity and is equivalent to the force required to bring the object to a stop in a unit length of time.

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	➢ **Charge conservation**, in physics, constancy of the total electric charge in the universe or in any specific chemical or nuclear reaction. • The total charge in any closed system never changes, at least within the limits of the most precise observation.

22. Consider the following pairs :

	Scientific technologies		***Principles***
1.	Tokamak	-	Magnetic confinement of plasma
2.	Neuromorphic computing	-	Spiking neural network
3.	Optical fibres	-	Total internal reflection of light

How many of the above pairs are correctly matched ?

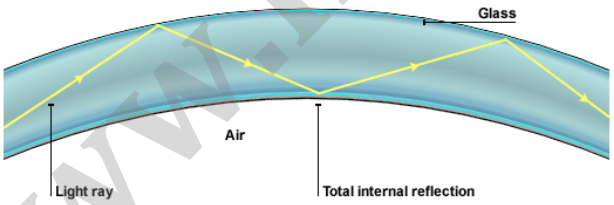
(a) Only one
(b) Only two
(c) All three
(d) None

EXPLANATION:

A tokamak is a machine that confines a plasma using magnetic fields in a donut shape that scientists call a torus. Fusion energy scientists believe that tokamaks are the leading plasma confinement concept for future fusion power plants. In a tokamak, magnetic field coils confine plasma particles to allow the plasma to achieve the conditions necessary for fusion. One set of magnetic coils generates an intense "toroidal" field, directed the long way around the torus. **So, Pair (1) is correct.**

Neuromorphic computing, also known as neuromorphic engineering, is an approach to computing that mimics the way the human brain works. It entails designing hardware and software that simulate the neural and synaptic structures and functions of the brain to process information. These neurological and biological mechanisms are modelled in neuromorphic computing systems through spiking neural networks (SNNs). A spiking neural network is a type of artificial neural network composed of spiking neurons and synapses. **So, Pair (2) is correct.**

Optical fiber uses the optical principle of "total internal reflection" to capture the light transmitted in an optical fiber and confine the light to the core of the fiber. An optical fiber is comprised of a light-carrying core in the center, surrounded by a cladding that acts to traps light in the core. Glass fiber is covered by a plastic buffer coating that protects it from the environment and allows easy handling for splicing or termination. **So, Pair (3) is correct.**



ADDITIONAL INFORMATION:

SCIENTIFIC TECHNOLOGIES	
About	Tokamak: • The heart of a tokamak is its doughnut-shaped vacuum chamber. • First developed by Soviet research in the late 1960s, the tokamak has been adopted around the world as the most promising configuration of magnetic fusion device. • ITER (International Thermonuclear Experimental Reactor) will be the world's largest tokamak twice the size of the largest machine currently in operation, with ten times the plasma chamber volume.

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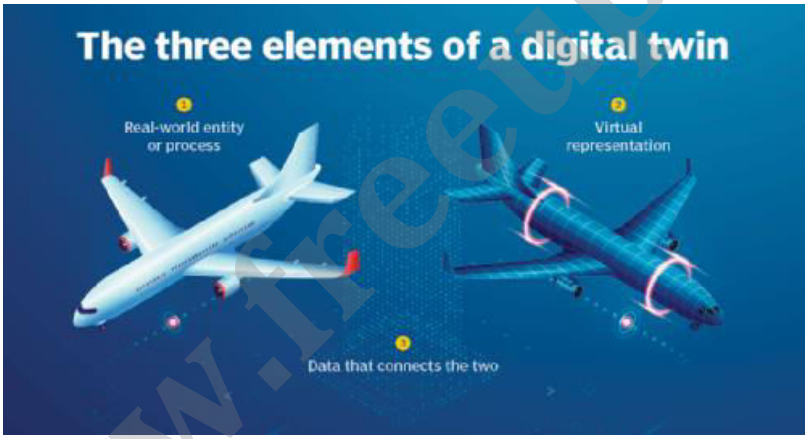
A Digital twin:

- Digital twins can replicate many real-world items, from single pieces of equipment in a factory to full installations, such as wind turbines and even entire cities.
- Digital twin technology allows overseeing the performance of an asset, identifying potential faults, and making better-informed decisions about maintenance and lifecycle.
- Digital twin technology uses machine learning algorithms to process the large quantities of sensor data and identify data patterns.
- Artificial intelligence and machine learning (AI/ML) provide data insights about performance optimization, maintenance, emissions outputs, and efficiencies.
- A number of industries are increasingly using digital twins to build virtual representations of their real-world systems. Some of them include the following. Construction, Manufacturing, Energy, Automotive and Healthcare.



Neuromorphic computing:

- Since neuromorphic computing takes inspiration from the human brain, it borrows heavily from biology and neuroscience.
- According to the Queensland Brain Institute, neurons “are the fundamental units of the brain and nervous system.
- As messengers, these nerve cells relay information between different areas of the brain and to other parts of the body.
- When a neuron becomes active or “spikes,” it triggers the release of chemical and electrical signals that travel via a network of connection points called synapses, allowing neurons to communicate with each other.
- As an adaptable technology, neuromorphic computing can be used to enhance a robot's real-time learning and decision-making skills, helping it better recognize objects, navigate intricate factory layouts and operate faster in an assembly line.

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23. With respect to Missions to planet Mars, consider the following statements :
    1. The Mars Orbiter Mission is the India's first interplanetary mission to study the Martian surface features, morphology and mineralogy and return the samples to the Earth.
    2. The MAVEN mission is the first mission by NASA to study the Martian upper atmosphere.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) **2 only**
    (c) Both 1 and 2
    (d) Neither 1 nor 2

EXPLANATION:

Mars Orbiter Mission (MOM), India's first interplanetary mission to planet Mars was launched on board PSLV-C25 on November 05, 2013. ISRO has become the fourth space agency to successfully send a spacecraft to Mars orbit. Though the designed mission life is 6 months, MOM completed 7 years in its orbit on Sept 24, 2021. MOM carries five scientific payloads to study the Martian surface features, morphology, mineralogy and Martian atmosphere. It does not return any of the samples to the Earth.
So, Statement 1 is not correct.

NASA's MAVEN (Mars Atmosphere and Volatile Evolution Mission) began its primary science mission in November 2014 and is the first spacecraft dedicated to understanding Mars' upper atmosphere. The mission's goal is to determine how the loss of atmospheric gas to space changed the Martian climate over time. MAVEN is studying the entire region from the top of the upper atmosphere down to the lower atmosphere to understand the connections between these regions. **So, Statement 2 is correct.**

ADDITIONAL INFORMATION:

MARS ORBITER MISSION	
Mission Objectives	The objectives of this mission are primarily technological and include designing, realizing, and launching a Mars Orbiter spacecraft capable of operating with sufficient autonomy during the journey. The mission also aims to study the Martian surface features, morphology, mineralogy, and atmosphere. SCIENTIFIC PAYLOADS-(instruments and equipment carried by spacecraft or robotic systems to collect data and perform experiments for research purposes.) ➢ Mars Color Camera (MCC) ➢ Thermal Infrared Imaging Spectrometer (TIS) ➢ Methane Sensor for Mars (MSM) ➢ Mars Exospheric Neutral Composition Analyser (MENCA) ➢ Lyman Alpha Photometer (LAP)
Uniqueness	• The highly elliptical orbit geometry of MOM enables its Camera (MCC) to take snapshots of the Full disc of Mars at its farthest point and finer details from the closest point.

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	• First time observing the far side of Deimos, one of the moons of Mars.
Achievements	• The Mars Colour Camera, one of the scientific payloads onboard MOM, has produced 1100+ images so far and published a Mars Atlas. • India's ability to successfully realize the complex mission to Mars in its first attempt, in a cost-effective (Rupees 450 Cr) has captured the world's attention and has propelled India's image as a credible space fairing nation to greater heights. This capability could pave the way for greater opportunities for Space Commerce including launch services and marketing of Satellite Imageries.

24. The 'Helmand, Harirod-Murghab, Panj-Amu' are the river basins of which among the following countries ?
    (a) Afghanistan
    (b) Bhutan
    (c) Nepal
    (d) Bangladesh

EXPLANATION:

In Afghanistan, river basins are divided into five river basins and found that two of the five are the major water sources for the country. It found that 28.6 billion cubic metres (BCM) of the country's water is generated in areas outside it. The researchers divided the country into five river basins for the purpose of the study:

- Harirod-Murghab River Basin (HMRB)
- Helmand River Basin (HRB)
- Kabul River Basin (KRB)
- Northern River Basin (NRB)
- Panj-Amu River Basin (PARB)

➢ At 51 per cent, the HRB is the largest river basin in Afghanistan. The Helmand is the longest and biggest river in southwest Afghanistan. It originates in the mountain range about 80 km west of Kabul and travels 1,150 km before draining into seasonal lakes along the Afghanistan-Iran border.

➢ The Harirod and Murghab rivers basin (HMRB) form the drainage system in the northwestern region. The Harirod River originates in the mountain range of central Afghanistan and flows westward across the Herat Valley. It is the main source of irrigation water for agriculture along the fertile lands of the valley. Morghāb River, rising in northwestern Afghanistan, flows generally west and forms the border between Afghanistan and Turkmenistan. It then continues into Turkmenistan, finally disappearing into the Karakum desert. The water yield from the HMRB is relatively small at about 6.5 BCM, which is 14 per cent of the total water yield within Afghanistan.

➢ The Panj-Amu River Basin (PARB) is mainly formed by the Amu Darya River — whose headstream is the Panj River. Known as Oxus in antiquity, the Amu Darya flows into Central Asia and ends in the now-dead Aral Sea. The Amu River originates in the glaciers of the Pamirs and drains an area of approximately 241,000 sq km in the northeastern and northern parts of Afghanistan.The Panj River, headstream of the Amu Darya in Central Asia. It is formed between the Hindu Kush and the Pamir Mountains.Melting glaciers and snow fields feed the Panj River, which crests in late spring. PARB is Afghanistan's second-largest basin, comprising 14.3 per cent of the country. It also overlaps into neighbouring Tajikistan; the water yield in the Panj-Amu basin largely depends on flow from neighbouring Tajikistan.

Therefore, the 'Helmand, Harirod-Murghab, and Panj-Amu' are the river basins of Afghanistan. **So, Option (a) is correct.**

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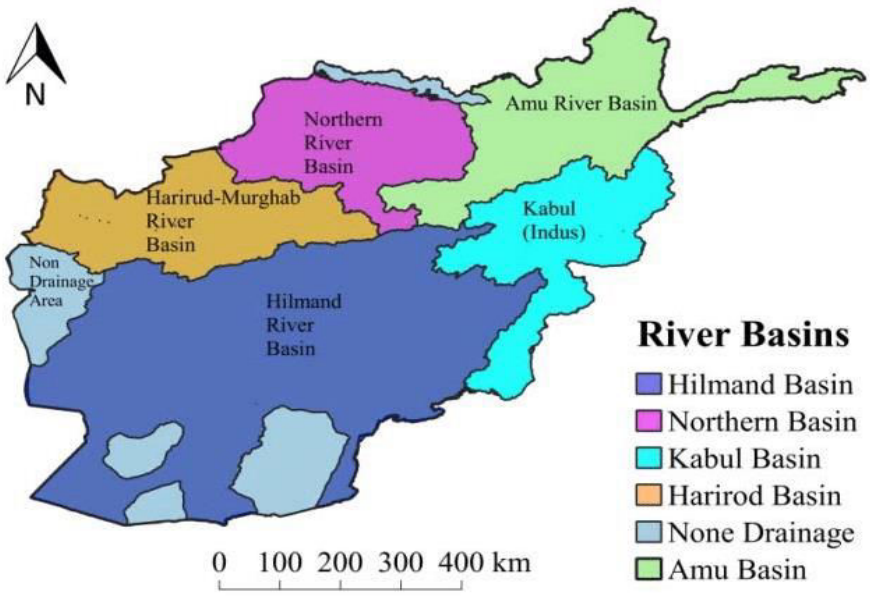

ADDITIONAL INFORMATION:

AFGHANISTAN RIVER BASINS	
Recently in News	Amu Darya and Kabul River basins are major sources of water for Afghanistan.
About	➢ Afghanistan's strategic location has led it to play an important role in regional geopolitics, which is increasingly playing out in natural resource contestations. ➢ Although it is a semi-arid country, around 80% of its water resources come from the snow-melt draining from its mountainous peaks. ➢ Except for the northern River basin, the remaining four are Transboundary nature and discharge into neighbouring countries. ➢ The Amu Darya is the longest river to pass through Afghanistan, while the Helmand is the longest river flowing within the country.The Amu Darya also flows through Tajikistan, Uzbekistan, and Turkmenistan.
Kabul River	➢ The Kabul River is 435 miles long emerging from the Hindu Kush Mountains in Afghanistan and then emptying to the Indus River in Attock, Pakistan. ➢ The major tributaries of the Kabul River are the Kunar, Bara, Swat, longer, and Panjshir. ➢ In the summer, the river swells and floods its banks due to the melting snow in the Hindu Kush. The Kunar tributary carries more water than the Kabul. River Kabul has many dams constructed along its course.

25. Consider the following statements :
    1. The surface web search engines cannot discover or display results for web pages within the dark web.
    2. The dark web is hidden by various network security measures like firewalls and encryption.
    3. The peer-to-peer (P2P) overlay network technique is used to TOR browsers to provide access to dark web.

    Which of the statements given above is/are ***not*** correct ?

    (a) 1 only
    (b) 1 and 2 only
    (c) 3 only
    (d) None

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EXPLANATION:

The open web, or surface web, is the "visible" surface layer. If we continue to visualize the entire web like an iceberg, the open web would be the top portion that's above the water. From a statistical standpoint, this collection of websites and data comprises under 5% of the total internet.

All commonly public-facing websites accessed via traditional browsers like Google Chrome, Internet Explorer, and Firefox are contained here. Websites can be easily located with popular search engines. Locating surface web websites is possible because search engines can index the web via visible links (a process called "crawling" due to the search engine travelling the web like a spider).

The Dark Web refers to sites that are not indexed and can only be accessed by specialized browsers. Significantly smaller than the Surface Web, the Dark Web is considered a part of the Deep Web.It is a very obscure part of the Deep Web that very few people can access.

The following features of the Dark Web create a paradise for anonymity:

- Web pages are unindexed by surface search engines. Google and other popular search engines cannot discover or display results for pages on the Dark Web. Therefore, surface web search engines cannot discover or display results for web pages within the dark web. **So, Statement 1 is correct.**
- "Virtual traffic tunnels" through a randomized network infrastructure.
- Inaccessible by traditional browsers due to its unique registry operator. In addition, it is concealed by various network security measures, such as firewalls and encryption. **So, Statement 2 is correct.**

The Tor (the onion routing) browser is designed for anonymous web surfing and protection against traffic analysis. Although Tor is often associated with the darknet and criminal activity, law enforcement officials, reporters, activists, whistleblowers and ordinary security-conscious individuals often use the browser for legitimate reasons.

The Tor browser works by using a technology known as onion routing. The onion router is a peer-to-peer (P2P) overlay network that enables users to browse the internet anonymously. Onion routing uses multiple layers of encryption to conceal both the source and destination of Information sent over the network. It is designed so no one can monitor or censor online communication. **So, Statement 3 is correct.**

ADDITIONAL INFORMATION:

DEEP WEB	
About	➢ The deep web rests below the surface and accounts for approximately 90% of all websites. This would be the part of an iceberg beneath the water, much larger than the surface web. This hidden web is so large that it's impossible to discover exactly how many pages or websites are active at any one time. ➢ Everything else, from academic journals to private databases and more illicit content, is out of reach. This deep web also includes the portion that we know as the dark web. Much of the deep portion as a whole is perfectly legal and safe. Some of the largest parts of the deep web include: • Databases: both public and privately protected file collections that are not connected to other areas of the web, only to be searched within the database itself. • Intranets: internal networks for enterprises, governments, and educational facilities used to communicate and control aspects privately within their organizations. ➢ Deep websites may be concealed behind passwords or other security walls, while others simply tell search engines not to "crawl" them. ➢ Most of these pages are kept hidden from the open web to protect user information and privacy, such as: • Financial accounts like banking and retirement • Email and social messaging accounts • Private enterprise databases • HIPPA sensitive Information like medical documentation • Legal files

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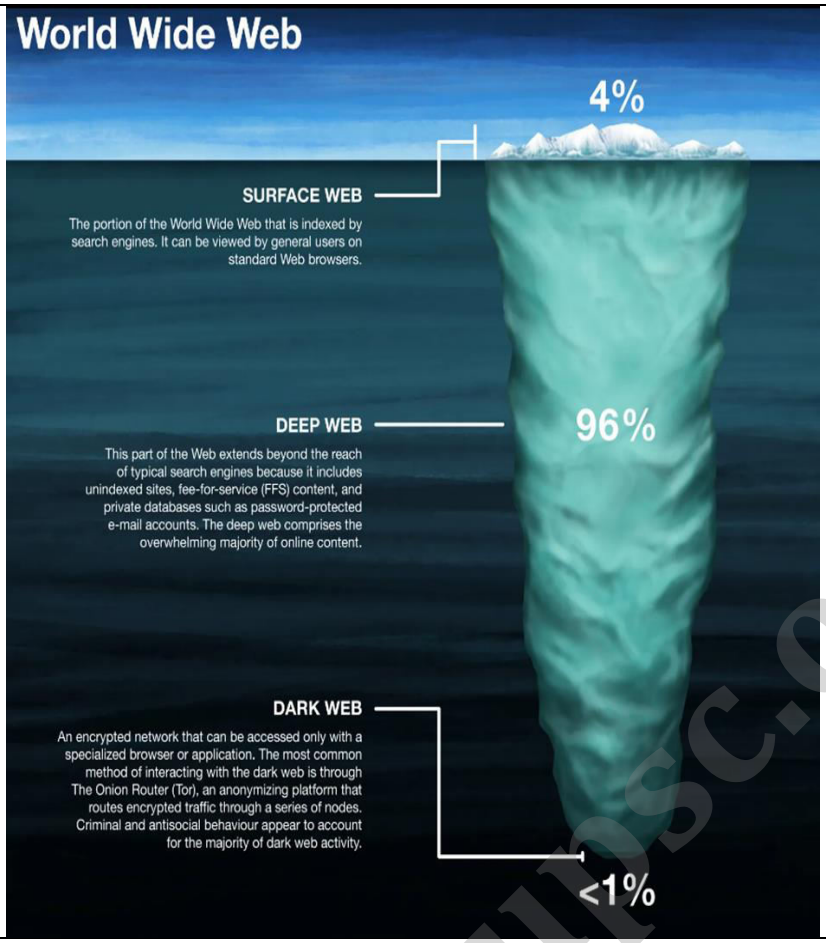
World Wide Web
4%
SURFACE WEB
The portion of the World Wide Web that is indexed by search engines. It can be viewed by general users on standard Web browsers.
DEEP WEB
This part of the Web extends beyond the reach of typical search engines because it includes unindexed sites, fee-for-service (FFS) content, and private databases such as password-protected e-mail accounts. The deep web comprises the overwhelming majority of online content.
96%
DARK WEB
An encrypted network that can be accessed only with a specialized browser or application. The most common method of interacting with the dark web is through The Onion Router (Tor), an anonymizing platform that routes encrypted traffic through a series of nodes. Criminal and antisocial behaviour appear to account for the majority of dark web activity.
<1%

26. End-to-end encryption (E2EE) is a type of messaging that keeps messages private from everyone, including the messaging service. How many of the following apps used in India has E2EE Facility ?
    1. What's App
    2. Telegram
    3. Gmail
    4. Instagram
    5. Facebook

    Choose the correct answer using the codes given below :

    (a) Only two
    (b) Only three
    (c) Only four
    (d) All five

EXPLANATION:

Encryption is a way of protecting data from unauthorised access or tampering. It works by transforming the data into a secret code that only the intended recipient can decipher. This comes in useful for various cases, such as securing online communications, storing sensitive information, and verifying digital identities. The term encryption is generally used when referring to the privacy of stored data, while end-to-end encryption protects data as it's transferred between locations which is crucial wherever there's a rapid exchange of information, like in WhatsApp.

- In India, the Apps that use end-to-end facilities are WhatsApp, Telegram, Facebook Messengers and Google Messages.
- In Instagram, The messages sent in Vanish Mode are encrypted end-to-end, which means that no one else can access them, not even the Instagram company.
- Gmail can encrypt the emails it sends and receives, but only when the other email provider supports TLS encryption. It does not use the E2EE facility. **So, Option (c) is correct.**

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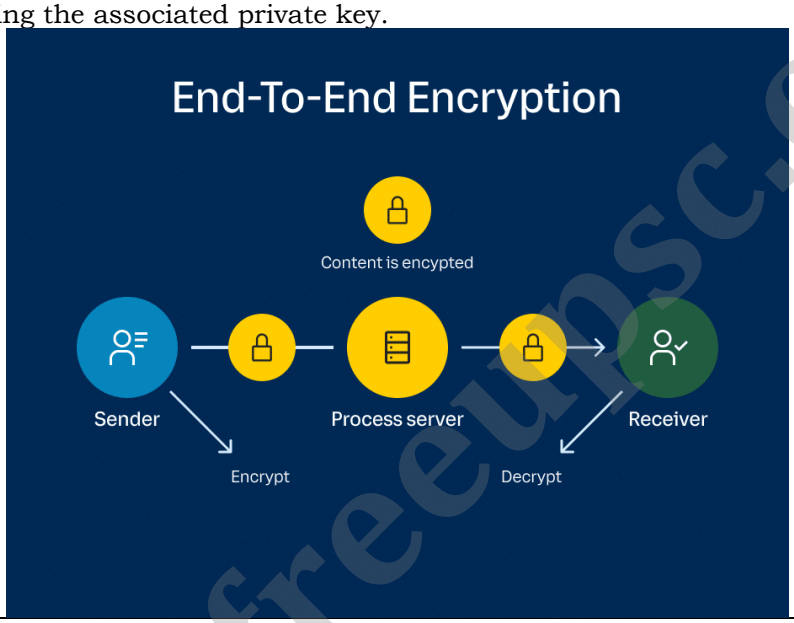
ADDITIONAL INFORMATION:

END TO END ENCRYPTION	
About	➢ End-to-end encryption protects data as it's transferred between locations. ➢ In an E2EE-enabled app, only the members on each end the sender and receiver can read any exchanged messages. Not even the messaging service provider. ➢ This is because messages get encrypted on your device before being sent and only are decrypted when they reach your intended recipient. So you've got complete privacy from snoopers, hackers, and even the company whose service you're using.
How does end-to-end encryption work?	➢ End-to-end encryption relies on an elegant yet complex cryptographic system to protect data in transit. ➢ The key element is asymmetric cryptography, which uses pairs of public and private keys to secure communications. The public key encrypts data, while the private key decrypts it. ➢ Users on an end-to-end encrypted system like WhatsApp each generate their own public-private key pairs. ➢ They widely distribute their public keys, which act like open locks anyone can use to send them encrypted messages. But those messages can only be unlocked and read by someone holding the associated private key. 
Benefits and drawbacks	➢ Benefits is that it protects users from hackers, criminals, overreaching governments, and even the companies providing the services. ➢ Drawbacks is that Law enforcement and national security agencies argue that the technology hampers their ability to detect dangerous or illegal activities. ➢ E2EE requires more computing resources and makes certain functions like search prohibitively difficult.

27. Which of the following is ***not*** an example of exothermic reactions ?
    (a) Burning of natural gas.
    (b) Decomposition of vegetable matter into compost.
    (c) **Decomposition of calcium carbonate to calcium oxide and carbon dioxide on heating.**
    (d) Breaking down of carbohydrates to form glucose, combines with oxygen to provide energy.

EXPLANATION:

Reactions in which heat is released along with the formation of products are called exothermic chemical reactions. Examples of exothermic reactions are

➢ Burning of natural gas
  $CH_4 (g) + 2O_2 (g) \rightarrow CO_2 (g) + 2H_2O (g)$
➢ The decomposition of vegetable matter into compost.

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- Respiration reaction process. During digestion, food is broken down into simpler substances. For example, rice, potatoes and bread contain carbohydrates. These carbohydrates are broken down to form glucose. This glucose combines with oxygen in the cells of our body and provides energy. The name of this reaction is respiration.

$$\underset{\text{(Glucose)}}{C_6H_{12}O_6(aq)} + 6O_2(aq) \rightarrow 6CO_2(aq) + 6H_2O(l) + \text{energ}$$

So, Options (a), (b) and (d) are not correct.

Reactions in which energy is absorbed are known as endothermic reactions.
The decomposition of calcium carbonate to calcium oxide and carbon dioxide on heating is an important decomposition reaction used in various industries. Calcium oxide is called lime or quick lime. It has many uses – one is in the manufacture of cement. When a decomposition reaction is carried out by heating, it is called thermal decomposition. Thermal decomposition of calcium carbonate is an endothermic reaction (Not an Exothermic reaction). **So, Option (c) is correct.**

$$\underset{\text{(Limestone)}}{CaCO_3(s)} \xrightarrow{\text{Heat}} \underset{\text{(Quick lime)}}{CaO(s)} + CO_2(g)$$

ADDITIONAL INFORMATION:

OXIDATION AND REDUCTION	
About	➢ If a substance gains oxygen or loses hydrogen during a reaction, it is said to be oxidised. ➢ If a substance loses oxygen or gains hydrogen during a reaction, it is said to be reduced.
Corrosion	➢ When a metal is attacked by substances around it, such as moisture, acids, etc., it is said to corrode, called corrosion. An oxidation reaction causes corrosion. ➢ The black coating on silver and the green coating on copper are other examples of corrosion. ➢ Corrosion causes damage to car bodies, bridges, iron railings, ships and all objects made of metals, especially those of iron.
Rancidity	➢ When fats and oils are oxidised, they become rancid and their smell and taste change. ➢ Usually substances which prevent oxidation (antioxidants) are added to foods containing fats and oil. Keeping food in air-tight containers helps to slow down oxidation. ➢ For example, chip manufacturers usually flush bags of chips with gas such as nitrogen to prevent the chips from getting oxidised.

28. Which of the following States has banned oleander flowers in temple offerings after a woman died after accidentally chewing the leaves of the oleander plant ?
    (a) **Kerala**
    (b) Tamil Nadu
    (c) Uttar Pradesh
    (d) Haryana

EXPLANATION:

Nerium oleander, commonly known as oleander or rosebay, is a plant cultivated worldwide in tropical, subtropical, and temperate regions. Known for its drought tolerance, the shrub is often used for ornamental and landscaping purposes. In Kerala, the plant is known by the names of arali and kanaveeram, and is grown along highways and beaches as a natural, green fencing.

- There are different varieties of oleander, each with a flower of a different colour.
- The Ayurvedic Pharmacopoeia of India (API), a government document that describes the quality, purity, and strength of drugs used in Ayurveda, mentions oleander. According to API, oil prepared from the root bark can be used to treat skin diseases.
- Even though it is prescribed in some ayurvedic formulations, oleander's toxicity has also long been

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recognised across the world, the plant has been "exploited therapeutically and as an instrument of suicide since antiquity. Moreover, ingestion or inhalation of smoke from burning oleander can also be intoxicating.

- Effects of oleander toxicity include nausea, diarrhea, vomiting, rashes, confusion, dizziness, irregular heartbeat, slow heartbeat, and, in extreme cases, death.

So, Kerala government-controlled temple boards, which together manage 2,500-odd temples in the state, have banned use of oleander flowers (locally known as arali) in temple offerings after a 24-year old woman died after accidentally chewing some oleander leaves. **So, Option (a) is correct.**

29. Consider the following statements :

Statement 1 *:*

The Gravitational force plays a key role in the formation and evolution of stars, galaxies and galactic clusters.

Statement 2 *:*

The gravitational force is the weakest force among the Fundamental forces in nature.

Which one of the following is correct in respect of the above statements ?

(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation of Statement I

(b) Both Statement I and Statement II are correct, but Statement II is not the correct explanation of Statement I

(c) Statement I is correct, but Statement II is incorrect

(d) Statement I is incorrect, but Statement II is correct

EXPLANATION:

The four fundamental forces of nature are:

- **Gravitational Force:** The weakest of the four forces, responsible for keeping objects on the ground and governing the motion of celestial bodies.
- **Electromagnetic Force:** A force with infinite range, responsible for interactions between charged particles, such as attraction and repulsion between positive and negative charges.
- **Strong Nuclear Force:** The strongest of the four forces, responsible for holding quarks together inside protons and neutrons, and holding these particles together inside atomic nuclei.
- **Weak Nuclear Force:** A force responsible for certain types of radioactive decay, where a nucleus emits particles to become more stable.

Gravitational force is the force that attracts objects with mass towards each other, and it is the dominant force governing the motion of celestial bodies in the universe.

It is the weakest force among the four Fundamental forces in nature. Gravity is an attractive force that draws two objects together. Its strength approximately increases with the masses of the two objects but decreases with the square of the distance between them.

That means that if the Moon were twice its current distance from Earth, the gravitational tug between the two would be just one fourth of what it is now.

Gravitational force is responsible for the formation of planetary systems, stars, and galaxies, as well as the orbits of these celestial bodies around each other. Gravitational force also plays a crucial role in the

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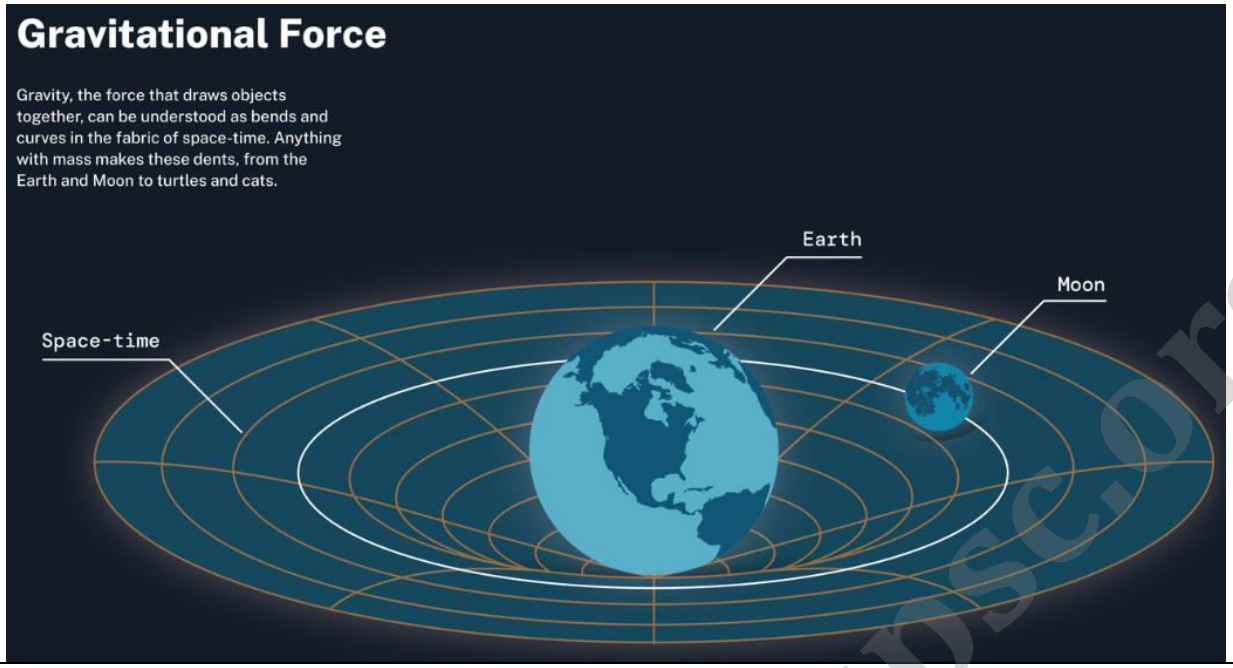
expansion and evolution of the universe, as described by the theory of general relativity and the concept of the inflationary universe.
However, while both statements are true, the weakness of the gravitational force does not explain its role in cosmic formation and evolution. Instead, gravity's long-range nature and cumulative effect (across massive distances and bodies) are what make it so influential on cosmic scales.
So, Both Statement I and Statement II are correct, and Statement II is not the correct explanation of Statement I.


Gravitational Force
Gravity, the force that draws objects together, can be understood as bends and curves in the fabric of space-time. Anything with mass makes these dents, from the Earth and Moon to turtles and cats.
Earth
Moon
Space-time

30. With reference to Multiple Independently Targetable Re-entry Vehicle (MIRV) technology, consider the following statements :
    1. It enables single missiles to target multiple locations hundreds of kilometres apart.
    2. India's longest-range ballistic missile, Agni-V, has been tested with this technology recently.
    3. MIRV-equipped missiles can be launched from land only.

    Which of the statements given above are correct ?
    (a) 1 only
    (b) 1 and 2 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

EXPLANATION:

A Multiple Independently Targetable Re-entry Vehicle (MIRV) is a ballistic missile payload designed for exo-atmospheric deployment, housing multiple warheads, each capable of targeting distinct objectives. While primarily associated with intercontinental ballistic missiles equipped with thermonuclear warheads, the concept extends beyond strict limitations. An intermediate variant, the Multiple Re-entry Vehicle (MRV) missile, disperses multiple warheads without individual targeting.These warheads can be designated for various targets spaced hundreds of kilometres apart. **So, Statement 1 is correct.**

The Agni-V is an Indian intercontinental ballistic missile (ICBM). It is an evolution of the Agni-III IRBM, featuring similar first- and second-stage motors with an added third stage. This was India's longest-range ballistic missile with a range of over 5,000 kilometres, tested with multiple independently targetable re-entry vehicle (MIRV) technologies under 'Mission Divyastra' by the Defence Research and Development Organisation (DRDO). **So, Statement 2 is correct.**

MIRV-equipped missiles can be launched from land or sea from a submarine. While India is now a part of the elite club, the countries which boast to possess MIRV, including: the USA, UK and France- have MIRV technology on their Submarine-Launched Ballistic Missile (SLBM). China- has MIRVed on Intercontinental Ballistic Missile (ICBM). Russia- has both MIRVed ICBMs and SLBMs. Pakistan is also believed to be experimenting with MIRV technology. **So, Statement 3 is not correct.**

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ADDITIONAL INFORMATION:

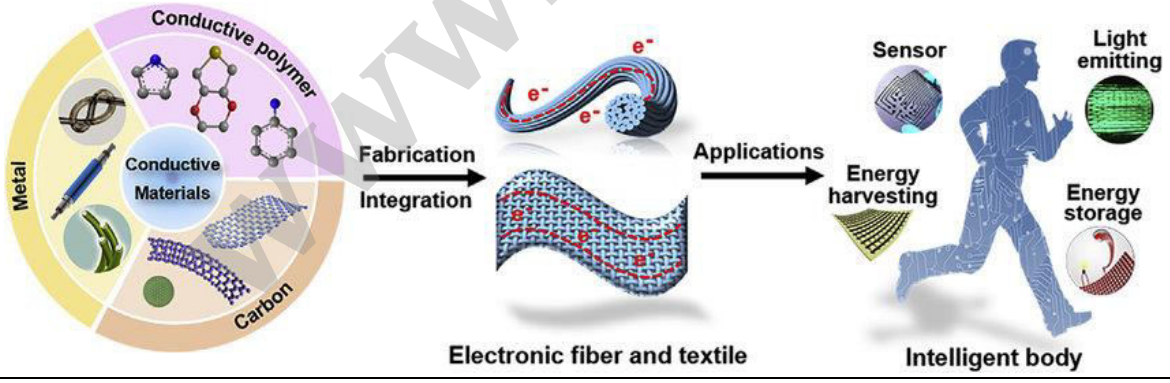
AGNI –V	
About	➢ The Agni-V is an Indian intercontinental ballistic missile (ICBM) with a range of over 5,000 km. It is an evolution of the Agni-III IRBM, featuring similar first- and second-stage motors with an added third stage. ➢ Unlike earlier missiles, the Agni-V launches from a sealed canister on a road-mobile launcher, compressing the time needed to prepare for launch. ➢ Jointly developed by the Defence Research & Development Organisation (DRDO) and Bharat Dynamics. ➢ Weighing close to 50,000 kilograms and standing at 1.75 meters tall with a diameter of two meters, the Agni-V boasts impressive specifications. ➢ It carries a formidable 1,500-kilogram warhead atop three-stage rocket boosters powered by solid fuel. ➢ The missile can clock 24 times faster than the speed of sound, reaching a staggering 8.16 km per second or 29,401 km per hour. ➢ The missile is equipped with advanced navigation systems, including a ring laser gyroscope inertial navigation system (NavIC) and satellite guidance. It ensures precise targeting capabilities, further enhanced by its launch flexibility from mobile launchers.

31. With respect to Electronic Fiber, consider the following statements :
    1. It utilises the human body as part of the Circuit.
    2. It enables wireless visual–digital interactions.
    3. It can work without the need of batteries or chips

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) **All three**
    (d) None

EXPLANATION:

The Electronic Fiber is a new form of flexible and wearable electronics on fibers or fabrics assembled with electronic functions provide platform for sensors, displays, circuitary and computation. The fibers light up in response to touch because they use the human body as part of a circuit that harvests ambient electromagnetic energy. This fiber is described as an "interactive fiber" or i-fiber. It is notable for its ability to harvest ambient electromagnetic energy for power, thereby enabling wireless visual-digital interactions. **So, Statements 1 and 2 are correct.**



Flexible electronic fiber incorporates the human body into its circuit, marking a significant advance in the creation of textiles embedded with electronic capabilities without relying on chips or batteries. This unique structure includes a core that generates an electromagnetic field, a middle layer that captures electromagnetic energy from the human body, and an outer optical layer that visually represents this energy. **So, Statement 3 is correct.**

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ADDITIONAL INFORMATION:

ELECTRONIC FIBER	
About	➢ Electronic fiber is a component of electronic textiles for developing wearable electronics. ➢ It is an ideal device platform for realizing the three-dimensional (3D) deformability, light weight, breathability, washability, and comfort required for e-textiles. ➢ The use of this technology will allow various electronic systems for computing, information technology, and communications to be easily incorporated in e-textiles, which can accommodate diverse functional fibers into an unlimited number of structures. For example, smart integrated textiles can be used to process and digitize mechanical, chemical, electrical, and thermal data gathered by fiber units that sense and react to the human body and the environment.

Fiber coupled to the body enables textile electronics

A flexible electronic fiber that utilises the human body as part of the circuit enables textile-based electronics without the need for batteries or chips, a study report. According to the researchers, the approach is well-suited for scalable manufacture of comfortable fiber-based electronics for a wide range of applications, including "smart" clothing. The soft, thin fiber that enables wireless visual-digital interactions utilises the human body as part of the circuit. The approach harvests electromagnetic energy.

32. Consider the following statements :
    1. The temple in Hampi is a prime example of Dravidian architecture.
    2. The sanctum sanctorum houses the Shiva lingam, the main object of worship.
    3. The temple is a UNESCO World Heritage Site.
    4. The temple gained prominence and underwent extensive expansion in the 14th century during the Vijayanagara Empire.

    Which of the following temples is described above ?

    (a) Chandikeswara temple
    (b) **Virupaksha temple**
    (c) Chausath yogini temple
    (d) Someshwara temple

EXPLANATION:

The city of Hampi bears exceptional testimony to the vanished civilization of the kingdom of Vijayanagar, which reached its apogee under the reign of Krishna Deva Raya (1509-30). The Virupaksha temple gained prominence and underwent extensive expansion in the 14th century during the Vijayanagara Empire (1336 to 1646). Founded by Harihara I of the Sangama dynasty, the Vijayanagara empire expanded from a strategic position on the banks of the Tungabhadra river to become one of the most powerful kingdoms of its time.

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Virupaksha temple is a prime example of Dravidian temple architecture, characterised by its grand gopurams (towering gateways), the shikhara towering over the sanctum sanctorum, its intricate carvings and pillared halls.

It is the 7th century Shiva temple in Hampi, Central Karnataka. The temple is a UNESCO World Heritage Site. The sanctum sanctorum houses the Shiva lingam, the main object of worship. Virupaksha Temple complex also houses shrines of Bhuvaneshwari and Vidyaranya. **So, Option (b) is correct.**

ADDITIONAL INFORMATION:

OTHER TEMPLES	
Chandikeshwara temple	➢ Chandikeshwara temple has majestic architecture and it was built during the period of the Vijayanagara Empire. ➢ It is situated on the main road to Hampi. ➢ The temple is dedicated to the Lord Vishu and is one of the prominent temples in Karnataka.
Chausath yogini temple	➢ The Chausath Yogini temple is in Mitaoli village (also spelled Mitawali or Mitavali), near Padaoli in Morena district 40 kilometres from Gwalior. ➢ According to an inscription dated to 1323 CE (Vikram Samvat 1383), the temple was built by the Kachchhapaghata king Devapala (1055 – 1075). It is said that the temple was the venue of providing education in astrology and mathematics based on the transit of the Sun. ➢ The Chausath Yogini Temple, Morena, also known as Ekattarso Mahadeva Temple, Standing atop an isolated hill of about hundred feet high. ➢ This temple is so named because of the presence of multitude of shivalingas inside its cells. This circular temple is one among the very few such temples in India. This is a yogini temple dedicated to sixty-four yoginis.

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Someshwara temple	➢ The temple is dedicated to Lord Shiva, the temple is believed to have been built during 1712 A.D, making it an integral part of Karnataka's cultural tapestry. The temple's architecture, rituals, and religious practices reflect the influence of various dynasties that have contributed to its development over the years. ➢ Someshwara is said to have been built by Mummadikempavira Gauda

33. Consider the following statements regarding the Agnibaan SOrTed-01 mission :
    1. It is India's first semi-cryogenic engine-powered rocket launched from a private launch pad.
    2. It is the world's first single-piece engine designed and built indigenously through additive manufacturing.
    3. The purpose of the mission is to serve as a test flight and to demonstrate the in-house and home grown technologies.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) **All three**
    (d) None

EXPLANATION:

SOrTeD (Sub-Orbital Technology Demonstrator) also has the unique distinction of having been launched from India's first private launch pad called 'Dhanush' established by Agnikul. It is also India's first semi-cryogenic engine-powered rocket launch.

➢ The key purpose of this mission, which is also Agnikul's first flight, is to serve as a test flight, to demonstrate in-house and home-grown technologies, gather crucial flight data and ensure optimal functioning of systems for Agnikul's orbital launch vehicle, the 'Agnibaan'. **So, Statements 1 and 3 are correct.**

The world's first single-piece 3D-printed engine designed and built indigenously. According to details shared by the start-up. Additive manufacturing is the process of creating an object by building it one layer at a time. It is the opposite of subtractive manufacturing, in which an object is created by cutting away at a solid block of material until the final product is complete.

Technically, additive manufacturing can refer to any process where a product is created by building something up, such as moulding, but it typically refers to 3-D printing. **So, Statement 2 is correct.**

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ADDITIONAL INFORMATION:

INDIGENOUS CRYOGENIC ENGINE AND STAGE	
About	A cryogenic engine/ cryogenic stage is the last stage of space launch vehicles which makes use of Cryogenics. Cryogenics is the study of the production and behaviour of materials at extremely low temperatures (below -150 degrees Centigrade) to lift and place heavier objects in space. ➢ The cryogenic stage is technically a much more complexed system with respect to solid or liquid fuel (stored on earth) stages due to the usage of propellants at extremely low temperatures. ➢ A cryogenic engine provides more force with each kilogram of cryogenic propellant it uses compared to other propellants, such as solid and liquid propellant rocket engines and is more efficient. ➢ The major components of a cryogenic rocket engine are a combustion/thrust chamber, igniter, fuel injector, fuel cryo pumps, oxidizer cryo pumps, gas turbine, cryo valves, regulators, fuel tanks and a rocket engine nozzle.
Rise of private players in space	➢ Agnikul and Skyroot represent the success of India's efforts to open up the space sector for private participation. ➢ Many space companies have come up in the last few years, operating in different space segments like market satellites, space-based applications, hardware, communications, data centres, and everything else. Many of them have already started to make their mark. ➢ Agnikul, the company, has built its launch pad inside the Sriharikota range with the help of ISRO. It uses a lot of ISRO's facilities, but the separate launchpad gives it the flexibility to schedule its launches whenever it wants.

34. Consider the following parts of a plant :
    1. Petiole
    2. Lamina
    3. Stamens
    4. Pistil
    5. Reticulate

    How many of the above are parts of a flower ?

    (a) Only two
    (b) Only three
    (c) Only four
    (d) All five

EXPLANATION:

The leaf is a lateral, generally flattened structure borne on the stem. They are the most important vegetative organs for photosynthesis. A typical leaf has three main parts: **Base, Petiole And Lamina**.

- The leaf is attached to the stem by the leaf base and may bear two lateral small leaf-like structures called stipules. In some leguminous plants, the leaf base may become swollen, called the 'Pulvinus'.
- The petiole helps hold the blade to light. Long, thin, flexible petioles allow leaf blades to flutter in the wind, thereby cooling the leaf and bringing fresh air to the leaf surface.
- The lamina, or the leaf blade, is the green expanded part of the leaf with veins and veinlets. There is usually, a middle prominent vein, known as the midrib.
- Veins provide rigidity to the leaf blade and act as channels of transport for water, minerals and food materials. The shape, margin, apex, surface and extent of incision of lamina vary in different leaves.

Therefore, Petiole and Lamina are parts of Leaf (Not the Flower). **So, Statements 1 and 2 are not correct.**

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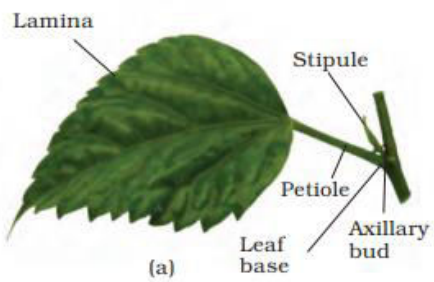
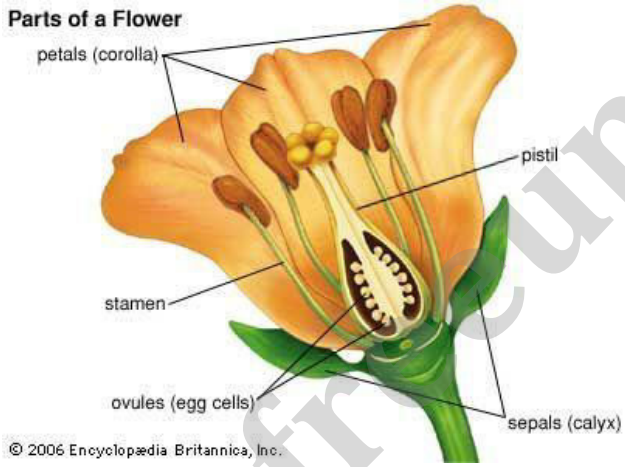
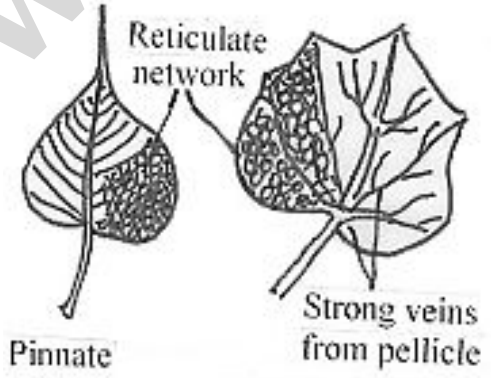


- Stamens are the male reproductive parts of a flowering plant. They are found in the centre of the flower, often alongside the stigma (if present). A stamen typically consists of two main components:
  - **Filament:** A long, slender stalk-like structure that supports the anther.
  - **Anther:** A two-lobed structure containing microsporangia, which produce pollen grains. Collectively, the stamens in a flower form the androecium. **So, Statement 3 is correct.**
- Pistils are the female reproductive organs of flowers. They consist of three main parts:
  - **Stigma:** The sticky surface at the top of the pistil that receives pollen from male flowers (anthers).
  - **Style:** The long, slender stalk that connects the stigma to the ovary.
  - **Ovary:** The base of the pistil that contains one or more ovules (eggs) where fertilization takes place.

In flowering plants, pistils play a crucial role in pollination and seed production. They provide a surface for pollen to land and germinate, allowing for fertilization to occur. **So, Statement 4 is correct.**



The arrangement of veins and the veinlets in the lamina of the leaf is termed venation. When the veinlets form a network, the venation is termed reticulate. The venation is termed parallel when the veins run parallel to each other within a lamina. Leaves of dicotyledonous plants generally possess reticulate venation, while parallel venation is characteristic of most monocotyledons. So, reticulate venation is related to the leaf and not with the flower. **So, Statement 5 is not correct.**



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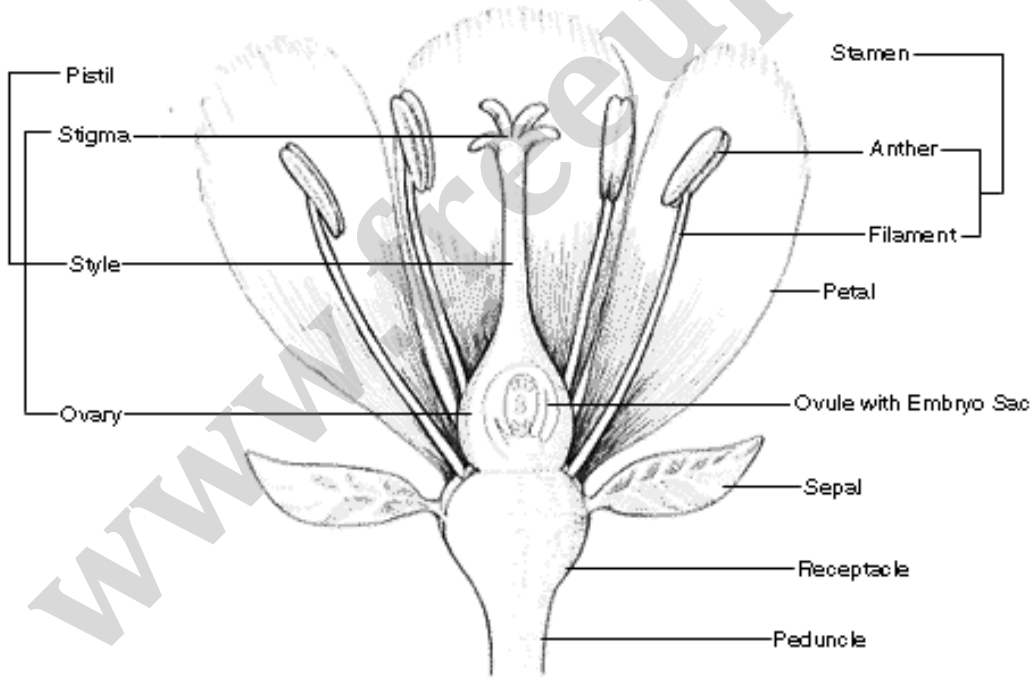
ADDITIONAL INFORMATION:

PARTS OF FLOWER	
About	The flower is the reproductive unit in the angiosperms. It is meant for sexual reproduction. A typical flower has four different kinds of whorls which are **Calyx, Corolla, Androecium** and **Gynoecium**. ➢ Calyx and corolla are accessory organs, while androecium and gynoecium are reproductive organs. In some flowers like lily, the calyx and corolla are not distinct and are termed as perianth. ➢ When a flower has both androecium and gynoecium, it is bisexual. A flower having either only stamens or only carpels is unisexual. ➢ The androecium is composed of stamens. Each stamen, which represents the male reproductive organ, consists of a stalk or a filament and an anther. The following are the parts of flowers: **Peduncle:** The stalk of a flower. **Receptacle:** The part of a flower stalk where the parts of the flower are attached. **Sepal:** The outer parts of the flower (often green and leaf-like) that enclose a developing bud. **Petal:** The parts of a flower that are often conspicuously coloured. **Stamen:** The pollen-producing part of a flower, usually with a slender filament supporting the anther. **Anther:** The part of the stamen where pollen is produced. **Pistil:** The ovule-producing part of a flower. The ovary often supports a long style, topped by a stigma. The mature ovary is a fruit, and the mature ovule is a seed. **Stigma:** The part of the pistil where pollen germinates. **Ovary:** The enlarged basal portion of the pistil where ovules are produced. 

35. With reference to the Small Satellite Launch Vehicle (SSLV), consider the following statements :
    1. It can carry payloads weighing up to 500 kg.
    2. The launch vehicle can be assembled in less than a week by a much smaller team.
    3. Currently, India has a share of participation of about 22% in the space economy along with Australia and Russia.

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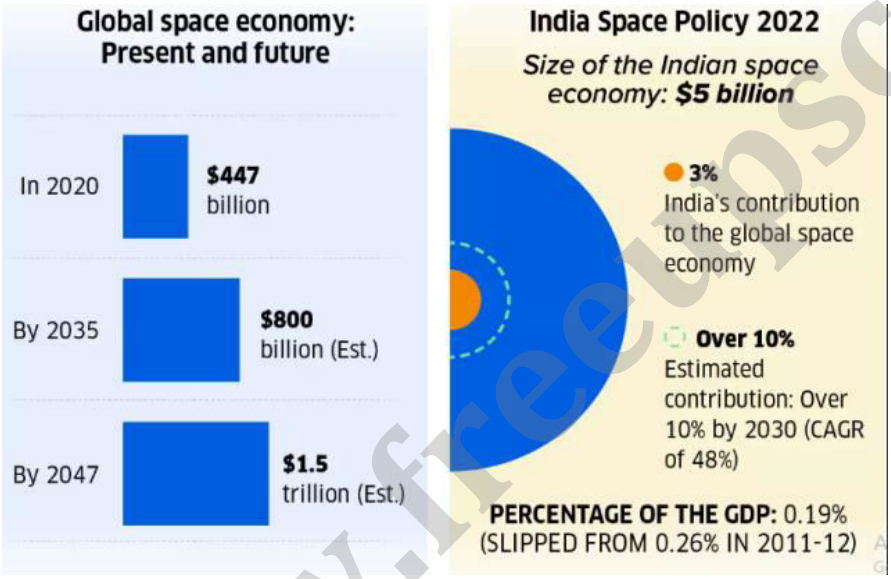
How many of the above statements are correct?

(a) Only one
(b) Only two
(c) All three
(d) None

EXPLANATION:

ISRO's Small Satellite Launch Vehicle (SSLV) is a three-stage Launch Vehicle configured with three Solid Propulsion Stages. It also has a liquid propulsion-based Velocity Trimming Module (VTM) as a terminal stage, which can help adjust the velocity as it prepares to place the satellite. Essentially, the aim behind SSLVs is to produce low-cost launch vehicles with short turnaround times and minimal infrastructural requirements. The Small Satellite Launch Vehicle (SSLV) can be assembled in less than a week by a significantly smaller team compared to traditional launch vehicles and it can launch satellites weighing up to 500kg and accommodate multiple satellites. **So, Statements 1 and 2 are correct.**

In India, there has been around 200 times increase in Space Start-ups in just about two years. This quantum jump has been possible because of a major policy decision to open up the Space sector to the private sector and allow public-private participation in a big way. The Indian space sector is recognized for building cost-effective satellites with the launch of the Mars probes successfully at the first attempt and taking hundreds of foreign satellites to space. India constitutes 2-3% of the global space economy and is expected to enhance its share to more than 10% by 2030. **So, Statement 3 is not correct.**



ADDITIONAL INFORMATION:

INDIA's LAUNCH VEHICLE	
About	➢ Launch vehicle, in spaceflight, is a rocket-powered vehicle used to transport a spacecraft beyond Earth's atmosphere, either into orbit around Earth or to some other destination in outer space. ➢ India has three active operational launch vehicles: Polar Satellite Launch Vehicle (PSLV), Geosynchronous Satellite Launch Vehicle (GSLV), and Geosynchronous Satellite Launch Vehicle Mk-III (LVM3).
Polar Satellite Launch Vehicle (PSLV)	➢ PSLV is configured with four variants like 6, 4, and 2 solid rocket strap-on motors & core-alone versions. ➢ Variants will be chosen based on the payload weights & orbit to be accomplished. ➢ PSLV has been a versatile launch vehicle deployed for launching all three types of payloads, viz. Earth Observation, Geo-stationary and Navigation. ➢ It has the highest success rate and is considered a workhorse of ISRO.

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Geosynchronous Satellite Launch Vehicle Mk-III (LVM3)	➢ GSLV with Indigenous Cryogenic Upper Stage has enabled the launching of up to the 2-tonne class of communication satellites. ➢ The LVM3 is the next-generation launch vehicle capable of launching a 4-tonne class of communication satellites and a 10-tonne class of payloads to LEOs. ➢ The vehicle was developed with indigenized technologies, including the C25 cryo stage. ➢ The launch vehicle has a track record of all successful launches, even from the first development flight. ➢ The human-rated LVM3 is identified as the launch vehicle for the Gaganyaan mission, named HRLV.

SLV-3
Height : 22.7m
Lift-off weight : 17 t
Propulsion : All Solid
Payload mass : 40 kg
Orbit : Low Earth Orbit
ASLV
Height : 23.5m
Lift-off weight : 39 t
Propulsion : All Solid
Payload mass : 150 kg
Orbit : Low Earth Orbit
PSLV-XL
Height : 44m
Lift-off weight : 320 t
Propulsion : Solid & Liquid
Payload mass : 1860 kg
Orbit : 475 km Sun Synchronous Polar Orbit (1300 kg in Geosynchronous Transfer Orbit)
GSLV Mk II
Height : 49m
Lift-off weight : 414 t
Propulsion : Solid, Liquid & Cryogenic
Payload mass : 2200 kg
Orbit : Geosynchronous Transfer Orbit
GSLV Mk III
Height : 43.43 m
Lift-off weight : 640 t
Propulsion : Solid, Liquid & Cryogenic
Payload mass : 4000 kg
Orbit : Geosynchronous Transfer Orbit

36. In which one of the following groups are all four countries members of BIMSTEC ?
    (a) Brazil, Iran, Saudi Arabia and Vietnam
    (b) Indonesia, Japan, South Korea and Singapore
    (c) Australia, Canada, Malaysia and New Zealand
    (d) **India, Sri Lanka, Nepal and Thailand**

EXPLANATION:

The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) is a regional organization that was established on 06 June 1997 with the signing of the Bangkok Declaration. Initially known as BIST-EC (Bangladesh-India-Sri Lanka-Thailand Economic Cooperation), the organisation is now known as BIMSTEC and comprises seven Member States with the admission of Myanmar on 22 December 1997, and Bhutan and Nepal in February 2004. On 06 June 1997, representatives of the Governments of Bangladesh, India, Sri Lanka, and Thailand came together in Bangkok, and signed the 'Declaration on the Establishment of the Bangladesh–India–Sri Lanka–Thailand Economic Cooperation (BIST-EC)'. The Member states of BIMSTEC are, Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka, Thailand. **So, Option (d) is correct.**

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ADDITIONAL INFORMATION:

BIMSTEC	
About	BIMSTEC is a five-tiered organization ➢ The Summit comprising the Heads of State or Government of the Member States ➢ The Ministerial Meeting comprising the Ministers dealing with foreign relations of the Member States ➢ The Sectoral Ministerial Meetings comprising the Ministers of line ministries responsible for carrying out the activities of the respective sectors ➢ The Senior Officials' Meeting consisting of the Foreign Secretaries/ Secretaries/ appropriate Senior officials nominated by the BIMSTEC Member States ➢ The BIMSTEC Permanent Working Committee (BPWC) comprising senior officials of the respective National Focal Points.

37. "Tetra chloroethene" is a compound that contaminates the ground water and is a suspected carcinogen. It is most likely used as a solvent in which of the following ?
(a) Bleaching of Paper
(b) Food Preservatives
(c) Solution to Clean Turbid Water
(d) **Dry Cleaning of Clothes**

EXPLANATION:

Tetra chlroroethene was used as solvent for dry cleaning earlier. It is suspected to be carcinogen and the compound contaminates the ground water. The process using this compound is now being replaced by a process, where liquefied carbondioxide, with a suitable detergent is used. Replacement of halogenated solvent by liquid CO2 will result in less harm to ground water. These days hydrogen peroxide (H2O2) is used for the purpose of bleaching clothes in the process of laundary, which gives better results and makes use of lesser amount of water. **So, Option (d) is correct.**

ADDITIONAL INFORMATION:

GREEN CHEMISTRY IN DAY TO DAY LIFE	
Bleaching of paper	➢ Chlorine gas was used earlier for bleaching paper. Hydrogen peroxide (H2O2) is used these days with suitable catalyst, which promotes the bleaching action of hydrogen peroxide.
Green solution to clean turbid water	➢ Powder of kernel of tamarind seeds has been found to be an effective material to make municipal and industrial waste water clean. ➢ It is non-toxic, biodegradable and costeffective material. This powder is usually discarded as agricultural waste. ➢ The present practice is to use alum to treat such water. It has been found that alum increases toxic ions in treated water and can cause diseases.

38. Consider the following statements :
Statement 1 :
Clean water would have more BOD value than highly polluted water.
Statement 2 :
The amount of Biological Oxygen Demand in the water measures of the amount of organic material in the water.
Which one of the following is correct in respect of the above statements ?
(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation of Statement I
(b) Both Statement I and Statement II are correct, but Statement II is not the correct explanation of Statement I
(c) Statement I is correct, but Statement II is incorrect
(d) **Statement I is incorrect, but Statement II is correct**

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EXPLANATION:

The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water is called Biochemical Oxygen Demand. The amount of BOD in the water is a measure of the amount of organic material in the water, in terms of how much oxygen will be required to break it down biologically. Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more. Thus, Clean water would have less BOD value than highly polluted water**. So, Statement I is not correct and, Statement II is correct.**

ADDITIONAL INFORMATION:

BIOLOGICAL OXYGEN DEMAND	
About	➢ BOD may be defined as the quantity of oxygen required during the stabilisation of decomposable organic matter and oxidisable inorganic matter by aerobic (oxidative) biological action. ➢ It is a measure that signifies the amount of oxygen dissolved in water required by different microorganisms present in it. BOD is, in a way, measurement of the oxidisable organic matter present in sewage. ➢ Higher BOD value signifies higher amount of oxidisable organic matter present and such a sewage is called strong, whereas weak sewage has comparatively less oxidisable matter.
Link between BOD and Eutrophication	➢ 'Eu' maens well or healthy and 'trophy' means nutrition. The enrichment of water bodies with nutrients causes entrophication of the water body. ➢ Discharge of domestic waste, agricultural surface runoff, land drainage and industrial effluents in a water body leads to rapid nutrients enrichment in a water body. ➢ The excessive nutrient enrichment in a water body encourages the growth of algae duckweed, water hyacinth, phytoplankton and other aquatic plants. ➢ The biological demand for oxygen (BOD) increases with the increase in aquatic organisms. ➢ As more plants grow and die, the dead and decaying plants and organic matter acted upon by heterotrophic prtozoans and bacteria, deplete the water of dissolved oxygen (DO). ➢ Decrease in DO result in sudden death of large population of fish and other aquatic organisms including plants, releasing offensive smell and makes the water unfit for human use. ➢ The sudden and explosive growth of phytoplankton and algae impart green colour to the water is known as water bloom, or "algal blooms". ➢ These phytoplankton release toxic substances in water that causes sudden death of large population of fishes. This phenomenon of nutrient enrichment of a water body is called eutrophication. ➢ Human activities are mainly responsible for the eutrophication of a growing number of lakes and water bodies in the country

39. Consider the following statements :
    1. The photoelectric emission is an instantaneous process that involves the conversion of electrical energy into light energy.
    2. All free electrons in a metal have the same energy.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

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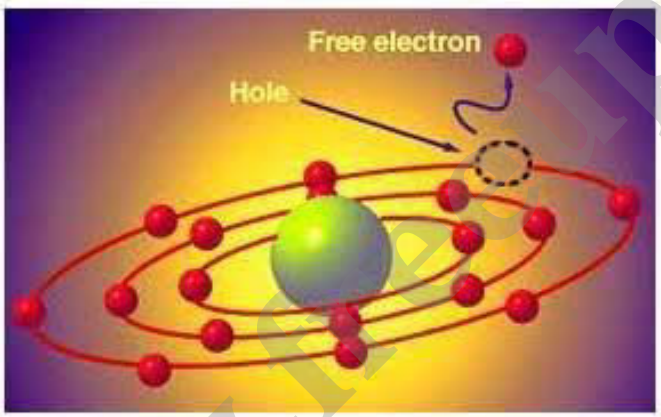
EXPLANATION:

Photoelectric emission is the process by which electrons are released from a metal surface when it is exposed to light. This phenomenon occurs when the energy of the incident light is sufficient to overcome the binding energy of the electrons to the metal atoms. The emitted electrons are called photoelectrons.
The phenomenon of photoelectric emission was discovered in 1887 by **Heinrich Hertz (1857-1894)** during his electromagnetic wave experiments.
In his experimental investigation on the production of electromagnetic waves by means of a spark discharge, Hertz observed that high voltage sparks across the detector loop were enhanced when the emitter plate was illuminated by ultraviolet light from an arc lamp. Under the right circumstances, light can be used to push electrons, freeing them from the surface of a solid.
Thus, the photoelectric emission is an instantaneous process that involves the conversion of light energy into electrical energy. **So, Statement 1 is not correct.**

Free electrons are electrons within a conducting substance, such as a metal, that are not permanently attached to any atom. They are loosely bound and can move freely within the material, carrying electrical current. This mobility is due to the delocalization of electrons in the outer shells of metal atoms, forming a "sea" of negative charge around the positive ions. The free electrons are not free to move out of the metal. They need additional energy to get out of the metal.
Free electrons in a metal do not all have the same energy. Like molecules in a gas jar, the electrons have a certain energy distribution at a given temperature. This distribution is different from the usual Maxwell's distribution. Because of the energy distribution of free electrons in a metal, the energy required by an electron to come out of the metal is different for different electrons.
Electrons with higher energy require less additional energy to come out of the metal than those with lower energies. Work function is the least energy required by an electron to come out of the metal.
Hence, All free electrons in a metal do not have the same energy. **So, Statement 2 is not correct.**



40. The term "Stellaria mcclintockiae", recently seen in the news, is related to :
    (a) **Plant species found in western ghats**
    (b) Butterfly species found in eastern ghats
    (c) Bird species found in western ghats
    (d) A mammal found in Himalayas

EXPLANATION:

A new plant species found on the high, muddy slopes of the Nelliyampathy hills in Kerala's Palakkad district has been named after Barbara McClintock, the American scientist who won the 1983 Nobel Prize for her discovery of the 'jumping genes.'
The new species belongs to the genus Stellaria (family Caryophyllaceae), and researchers have christened it Stellaria mcclintockiae. It is the first species of the genus Stellaria reported from south India.
It is an annual herb growing up to 15 cm in height. Known to be found only in the Nelliyampathy hills as of now, and that too at an elevation of 1,250-1,400 meters, Stellaria mcclintockiae differs from other species of this genus with respect to the features of its petals, pollen morphology, bracts, sepals, and seed architecture. **So, Option (a) is correct.**

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ADDITIONAL INFORMATION:

BARBARA MCCLINTOCK	
About	➢ Barbara McClintock (1902 – 1992) was an American cytogeneticist who devoted her life to science. ➢ She was the 3rd woman to receive an unshared Nobel Prize "for her discoveries of mobile genetic elements". ➢ A pioneer in the field of genetics in maize (corn) cells, she discovered that genes can change position between and within chromosomes (genetic transposition or "jumping genes"). ➢ Improved molecular techniques finally confirmed her theory in the early 1980s, changing the concept of what genes are capable of and leading to the Nobel Prize in Physiology or Medicine in 1983 – more than 30 years after her first discovery.

41. With reference to semiconductors, consider the following statements :
    1. Electric vehicles use power management chips which have high voltage and high current applications.
    2. At zero kelvin temperature, intrinsic semiconductors show properties similar to insulators.
    3. Doping helps in increasing the conductivity of a pure semiconductor.
    4. Light emitting diodes are heavily doped semiconductors that convert mechanical energy into light.

    Which of the above statements is/are correct ?
    (a) 1, 2 and 4 only
    (b) 2, 3 and 4 only
    (c) 1, 2, 3, and 4
    (d) 1, 2 and 3 only

EXPLANATION:

Electric vehicles, also called battery electric vehicles (BEVs), have an electric motor instead of an internal combustion engine. The vehicle uses a large traction battery pack to power the electric motor and must be plugged into a wall outlet or charging equipment, also called electric vehicle supply equipment (EVSE).
Electric vehicle uses power management chips. It is also used in telecom, defence, automotive, consumer electronics, display, power electronics, etc. Power management chips are high voltage, high current applications. **So, Statement 1 is correct.**

Pure semiconductors are called 'intrinsic semiconductors'. The presence of charge carriers (electrons and holes) is an 'intrinsic' property of the material, and these are obtained as a result of thermal excitation. The number of electrons (ne) is equal to the number of holes in intrinsic conductors. Holes are essentially electron vacancies with an effective positive charge. An intrinsic semiconductor will behave like an insulator at T = 0 K. Therefore, at zero kelvin temperature, intrinsic semiconductors show properties similar to insulators. **So, Statement 2 is correct.**

The conductivity of an intrinsic semiconductor depends on its temperature, but at room temperature, its conductivity is very low. As such, no important electronic devices can be developed using these semiconductors. Hence there is a necessity of improving their conductivity. This can be done by making use of impurities. When a small amount, say, a few parts per million (ppm) of a suitable impurity is added to the pure semiconductor, the conductivity of the semiconductor is increased manifold. Such materials are known as extrinsic semiconductors or impurity semiconductors. The deliberate addition of a desirable impurity is called doping, and the impurity atoms are called dopants. Such a material is also called a doped semiconductor. **So, Statement 3 is correct.**

Light-emitting diodes (LED) are optoelectronic devices. It converts electrical energy into light. It is a heavily doped p-n junction which, under forward bias, emits spontaneous radiation. LEDs emitting red, yellow, orange, green and blue light are commercially available. Extensive research is being done for developing white LEDs which can replace incandescent lamps.
LEDs have the following advantages over conventional incandescent low-power lamps such as

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- Low operational voltage and less power
- Fast action and no warm-up time are required.
- Long life and ruggedness,
- Fast on-off switching capability, etc., **So, Statement 4 is not correct.**

ADDITIONAL INFORMATION:

SEMICONDUCTORS	
About	➢ Semiconductors are the basic materials used in solid-state electronic devices like diodes, transistors, ICs, etc. ➢ Semiconductors are mostly used for developing electronic devices. Silicon and germanium are the most familiar semiconductor materials. Normally, the conductivity of a semiconductor lies in–between the conductivities of metals and insulators. ➢ At absolute zero, the semiconductor also acts like a perfect insulator. The conductivity of a semiconductor is influenced by adding some impurity element called a dopant.

42. Which of the following best describes "SAGA-220" ?
    (a) An AI tool to determine the age of a foetus in a pregnant woman
    (b) A supercomputer developed by ISRO
    (c) A Supersonic missile developed by DRDO
    (d) A new variety of cocoa developed by ICAR

EXPLANATION:

The Indian Space Research Organisation (ISRO) has built India's fastest supercomputer in terms of theoretical peak performance. "SAGA-220" (Supercomputer for Aerospace with GPU Architecture-220 TeraFLOPS) 220 trillion floating point operations per second (FLOPS), for solving complex aerospace problems.

The supercomputer was fully designed and built by the space centre using commercially available hardware and open-source software components. The system was environmentally green and consumed only 150 kW of power. Floating-point operations per second (FLOPS) is a measure of a computer's performance based on the number of floating-point arithmetic calculations that the processor can perform within a second. **So, Option (b) is correct.**

ADDITIONAL INFORMATION:

SUPERCOMPUTER	
Definition	➢ Supercomputers are high-performing mainframe systems that solve complex computations. They split tasks into multiple parts and work on them in parallel, as if there were many computers acting as one collective machine. ➢ Initially developed for nuclear weapon design and code-cracking, supercomputers are used today by scientists and engineers to test simulations that help predict climate changes and weather forecasts, explore cosmological evolution and discover new chemical compounds for pharmaceuticals.
How it works?	➢ An operation is split into smaller parts, where each piece is sent to a CPU to solve. These multi-core processors are located within a node, alongside a memory block. ➢ In collaboration, these individual units — as many as tens of thousands — communicate through inter-node channels called interconnects to enable concurrent computation.
Supercomputers and Artificial Intelligence	➢ Supercomputers can train various AI models at quicker speeds while processing larger, more detailed data sets . ➢ Plus, AI will actually lighten a supercomputer's workload, as it uses lower precision calculations that are then cross-checked for accuracy.

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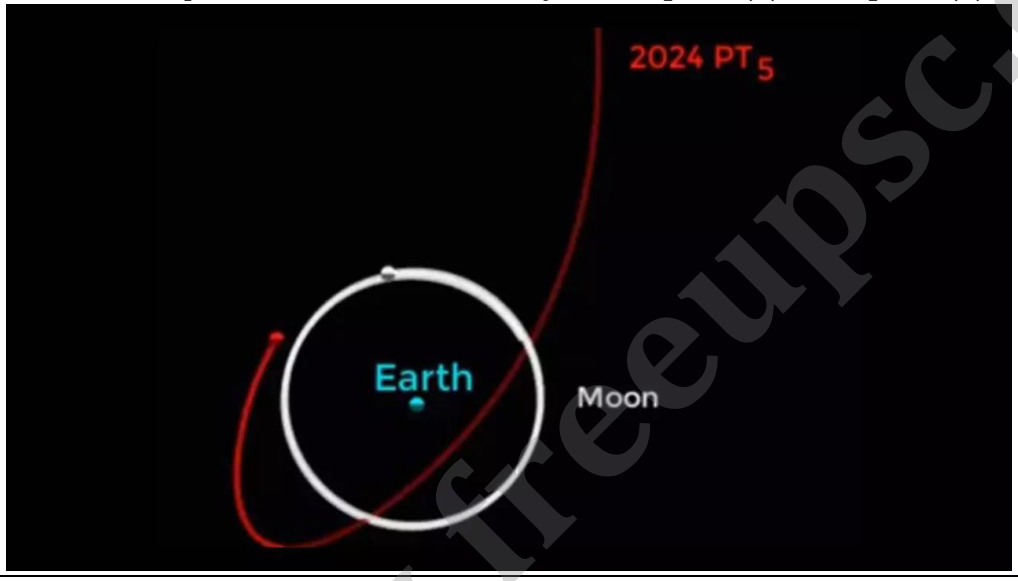
	➢ AI heavily relies on algorithms, which, over time, lets the data do the programming. ➢ Paired together, AI and supercomputers have boosted the number of calculations per second of today's fastest supercomputer by an interval of six.

43. Which of the following statements is ***not*** correct with reference to "2024 PT5", recently seen in the news ?
    (a) It is an asteroid that has been pulled into Earth's orbit, making it a temporary "mini-moon."
    (b) It originates from a group of Near-Earth asteroids that share a similar orbit around the sun as Earth.
    (c) It will circle the Earth for only 57 days before resuming its journey through space.
    (d) It is the first such event to be reported in more than a century

EXPLANATION:

The small near-Earth asteroid 2024 PT5 was first observed by the Sutherland, South Africa telescope of the University of Hawai'i's Asteroid Terrestrial-impact Last Alert System (ATLAS), which is funded by NASA. Estimated to be about 33 feet (10 meters) wide, the asteroid does not pose a hazard to Earth.PT5 is an asteroid that has been pulled into Earth's orbit, making it a temporary moon.
The asteroid 2024 PT5 is not a mini-moon technically, as it will not complete one full revolution around Earth but will remain in the planet's orbit for over 56 days. **So, Option (a) and Option (c) are correct**.



2024 PT5 originates from the Arjuna's asteroid belt, a group of Near-Earth objects (NEOs) that share a similar orbit around the sun as earth. This asteroid is named after the legendary archer Arjuna from Mahabharata, highlighting their swift and sometimes unpredictable movement through space.
So, Option (b) is correct.

Mini-moon events like 2024 PT5's visit are not entirely unprecedented. Similar phenomena have been recorded in 1997, 2013, 2018, and more recently in 2022.
The first mini moon named 1991VG was spotted back in 1991.While the first mini-moon did not complete a full revolution around the planet like the newly captured PT5 asteroid, Earth did have a mini-moon that orbited for a full year. Discovered in 2006, Asteroid 2006 RH120 remained in our planet's gravitational pull until July 2007. **So, Option (d) is not correct.**

44. Recently, for the first time, India has set up its own pavilion at the World Hydrogen Summit 2024, which was held in :
    (a) Stockholm, Swedan
    (b) **Rotterdam, Netherland**
    (c) Berlin, Germany
    (d) Brussels, Belgium

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EXPLANATION:

The World Hydrogen Summit is a prestigious global green hydrogen ecosystem event. Around 15,000 delegates from around the world are attending the Summit.
India has set up its pavilion for the first time at the World Hydrogen Summit 2024, held in Rotterdam, Netherlands, during May 13 – 15, 2024.
The India Pavilion, set up by the Ministry of New & Renewable Energy, Government of India, is one of the largest pavilions at the Summit. Rotterdam is known as the Maritime Capital of Europe**,** and, with its impressive Port of Rotterdam, it's considered a world leader in hydrogen projects. **So, Option (b) is correct.**

ADDITIONAL INFORMATION:

WORLD HYDROGEN SUMMIT 2024	
About	The Sustainable Energy Council, in partnership with the Government of the Netherlands, the Province of Zuid-Holland,the City of Rotterdam & Port of Rotterdam**,** organizedtheWorld Hydrogen 2024 Summit & Exhibition, whichtook place in Rotterdam on 13 – 15 May 2024.
National Hydrogen Mission	➢ India launched its National Green Hydrogen Mission in January 2023. ➢ India has set an ambitious target to achieve a green hydrogen production capacity of 5 million tonnes by the end of 2030. ➢ The overarching objective of the Mission is to make India the Global Hub for the production, usage and export of Green Hydrogen and its derivatives. ➢ This will contribute to India's aim to become Aatmanirbhar (self-reliant) through clean energy and inspire the global Clean Energy Transition. ➢ The Mission will lead to significant decarbonization of the economy, reduced dependence on fossil fuel imports, and enable India to assume technology and market leadership in Green Hydrogen. ➢ India as a whole also aims to reduce the emissions intensity of GDP by 45 per cent and commits to net-zero emissions by 2070.

45. According to this phenomenon, while approaching a stationary source of sound with high speed, the pitch of the sound heard appears to be higher than that of the source and as the distance between observer and the source increases, the observed pitch becomes lower than that of the source. It is commonly used to check overspeeding of vehicles. This phenomenon also has applications in areas such as military, medical science, astrophysics, etc.
Which of the following denotes the above described phenomenon ?
(a) Theory of sonics
(b) Fizeau effect
(c) Tyndall effect
(d) Doppler effect

EXPLANATION:

The Doppler effect is a physical phenomenon where the frequency of a wave changes when the source of the wave and the observer are in relative motion. This change in frequency occurs due to the difference in the distance between the source and observer as they move past each other.
The Austrian physicist Johann Christian Doppler first proposed the effect in 1842. Buys Ballot in Holland tested it experimentally in 1845.
The change in frequency caused by a moving object due to the Doppler effect has significant implications in various scientific disciplines, including astronomy (tracking celestial objects), radar technology (tracking moving targets), and medicine (measuring blood flow).
➢ It is also used by police to check over speeding of vehicles.
➢ It is used at airports to guide aircraft, and in the military to detect enemy aircraft.
➢ Astrophysicists use it to measure the velocities of stars.
➢ Doctors use it to study heart beats and blood flow in different parts of the body. Here they use ultrasonic waves, and in common practice, it is called sonography. Ultrasonic waves enter the body of

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the person, some of them are reflected back, and give information about motion of blood and pulsation of heart valves, as well as pulsation of the heart of the foetus. In the case of heart, the picture generated is called echo cardiogram. Hence, the said phenomenon is Doppler effect. **So, Option (d) is correct.**

Figure 1. Sounds emitted by a source spread out in spherical waves. Because the source, observers, and air are stationary, the wavelength and frequency are the same in all directions and to all observers.

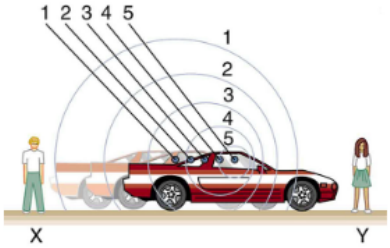

Figure 2. Sounds emitted by a source moving to the right spread out from the points at which they were emitted. The wavelength is reduced and, consequently, the frequency is increased in the direction of motion, so that the observer on the right hears a higher-pitch sound. The opposite is true for the observer on the left, where the wavelength is increased and the frequency is reduced.

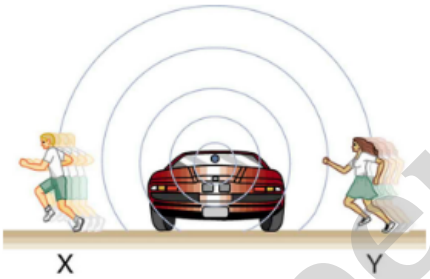

Figure 3. The same effect is produced when the observers move relative to the source. Motion toward the source increases frequency as the observer on the right passes through more wave crests than she would if stationary. Motion away from the source decreases frequency as the observer on the left passes through fewer wave crests than he would if stationary.

ADDITONAL INFORMATION:

PRINCIPLE OF SUPERPOSITION AND THEORY OF SONICS	
Principle of Superposition	➢ Principle of superposition, in wave motion is that when two or more waves overlap in space, the resulting disturbance is equal to the algebraic sum of the individual disturbances. This principle holds for many different kinds of waves, such as waves in water, sound waves, and electromagnetic waves. ➢ Because of the principle of superposition, the old saying that no two things can occupy the same space at the same time does not apply to waves. Indeed,

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	an infinite number of waves can occupy the same space at the same time. ➢ Furthermore, they do this without affecting one another, so that each wave retains its own character independent of how many other waves are present at the same point and time. ➢ A radio or television antenna can receive the signal of any single frequency to which it is tuned, regardless of the existence of any others. ➢ Likewise, the sound waves of two people talking may cross each other, but the sound of each voice is unaffected by the waves' having been simultaneously at the same point.
Theory of Sonics	➢ Theory of Sonics is the science dealing with the transmission of power by periodic forces and motions through liquids, solids and gases. ➢ George Constantinesco discovered that these phenomena had their analogies not only with the properties of sound waves and the laws of harmony, but also with AC electrical circuits. ➢ Prototypes of rock drills working on the percussion system and polyphase rotary systems were already being demonstrated by 1913. The most important application of his theory of sonics was a "synchroniser gear" which allowed to fire a machine gun through the aircraft propeller.

46. Arrange the following phenomena in the order of increasing energy in terms of Joules :
    1. Thunderstorm
    2. Big bang
    3. Rotational energy of the earth
    4. Energy to break one bond in DNA

    Select the correct answer using the code given below

    (a) 1-3-2-4
    (b) 4-1-3-2
    (c) 2-3-1-4
    (d) 3-4-2-1

EXPLANATION:

Joule (J) is the standard unit of measurement for energy in the International System of Units (SI). It is defined as the energy required to move an object one meter in the direction of the force of one Newton. . One joule is equal to one-kilogram meter squared per second squared. Arrangement of phenomena in the order of increasing energy in terms of Joules are as follows:

- Energy to break one bond in DNA: 10^{-20} Joules
- Thunderstorm: 10^{15} Joules
- Rotational energy of the Earth: 10^{29} Joules
- Big Bang: 10^{68} Joules **So, Option (b) is correct.**

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Table 6.3 Approximate energy associated with various phenomena

Description	Energy (J)
Big Bang	10^{68}
Radio energy emitted by the galaxy during its lifetime	10^{55}
Rotational energy of the Milky Way	10^{52}
Energy released in a supernova explosion	10^{44}
Ocean's hydrogen in fusion	10^{34}
Rotational energy of the earth	10^{29}
Annual solar energy incident on the earth	5×10^{24}
Annual wind energy dissipated near earth's surface	10^{22}
Annual global energy usage by human	3×10^{20}
Annual energy dissipated by the tides	10^{20}
Energy release of 15-megaton fusion bomb	10^{17}
Annual electrical output of large generating plant	10^{16}
Thunderstorm	10^{15}
Energy released in burning 1000 kg of coal	3×10^{10}
Kinetic energy of a large jet aircraft	10^{9}
Energy released in burning 1 litre of gasoline	3×10^{7}
Daily food intake of a human adult	10^{7}
Work done by a human heart per beat	0.5
Turning this page	10^{-3}
Flea hop	10^{-7}
Discharge of a single neuron	10^{-10}
Typical energy of a proton in a nucleus	10^{-13}
Typical energy of an electron in an atom	10^{-18}
Energy to break one bond in DNA	10^{-20}

ADDITIONAL INFORMATION:

THE INTERNATIONAL SYSTEM OF UNITS (SI)

SI Base Quantities and Units

Table 2.1 SI Base Quantities and Units*

Base quantity	SI Units		
	Name	Symbol	Definition
Length	metre	m	The metre is the length of the path travelled by light in vacuum during a time interval of 1/299,792,458 of a second. (1983)
Mass	kilogram	kg	The kilogram is equal to the mass of the international prototype of the kilogram (a platinum-iridium alloy cylinder) kept at international Bureau of Weights and Measures, at Sevres, near Paris, France. (1889)
Time	second	s	The second is the duration of 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom. (1967)
Electric current	ampere	A	The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length. (1948)
Thermo dynamic Temperature	kelvin	K	The kelvin, is the fraction 1/273.16 of the thermodynamic temperature of the triple point of water. (1967)
Amount of substance	mole	mol	The mole is the amount of substance of a system, which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon - 12. (1971)
Luminous intensity	candela	cd	The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian. (1979)

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47. Consider the following statements :

Statement-I :

The light passing into the event horizon of the Black Hole cannot escape into space.

Statement II :

In the Event horizon, the escape velocity is greater than the velocity of light.

Which one of the following is correct in respect of the above statements ?

(a) Both Statement-I and Statement-II are correct, and Statement-II explains Statement-I

(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I

(c) Statement I is correct, but Statement II is incorrect

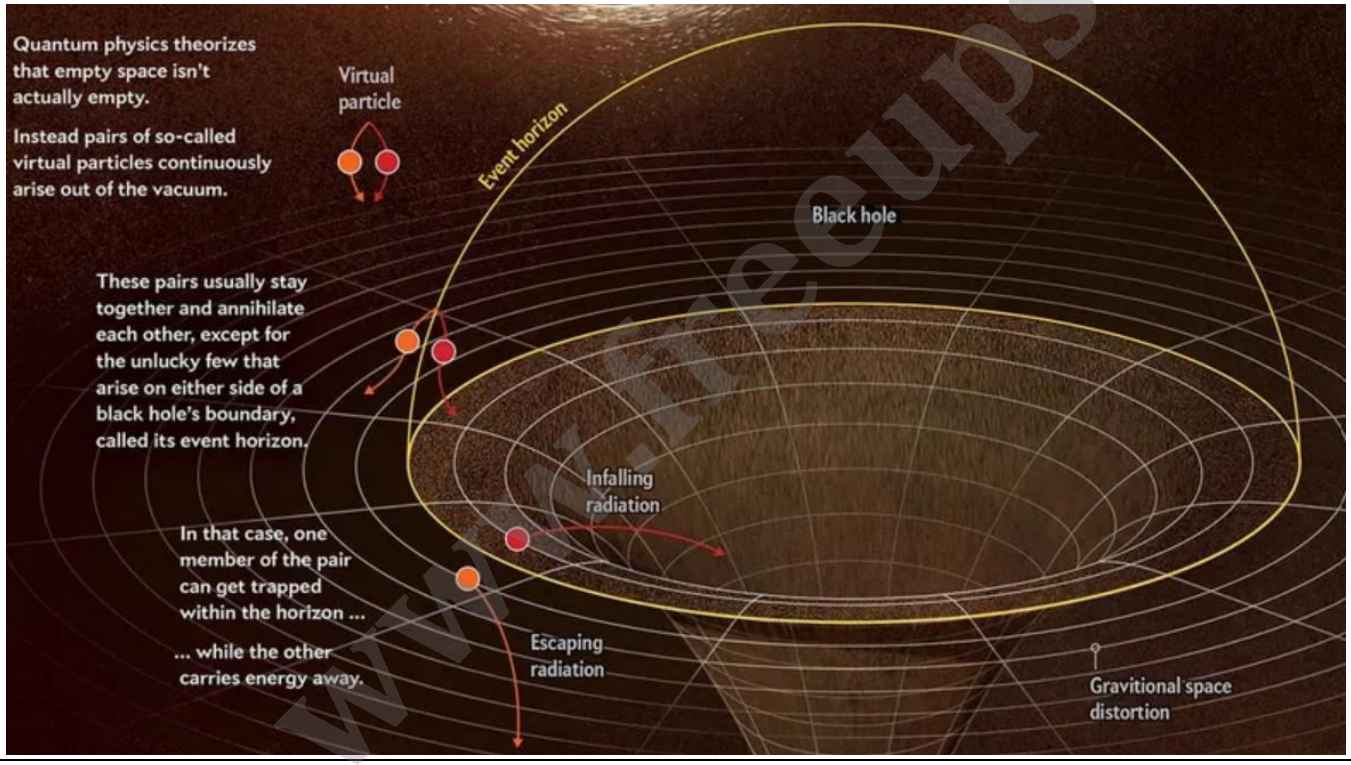
(d) Statement I is incorrect, but Statement II is correct

EXPLANATION:

The Event Horizon is the surface or boundary of a black hole, marking the point of no return. It is the point where the gravitational pull becomes so strong that not even light can escape from within the black hole. Once something crosses the Event Horizon, it is trapped by the black hole's gravity and cannot escape. Black holes are huge concentrations of matter packed into very tiny spaces. A black hole is so dense that gravity just beneath its surface, the event horizon, is strong enough that nothing i.e. not even light can escape.

Inside the boundary of event horizon the velocity needed to escape the black hole exceeds the speed of light, which is as fast as anything can go. So whatever passes into the event horizon is doomed to stay inside it even light. Because light can't escape, black holes themselves neither emit nor reflect it, and nothing about what happens within them can reach an outside observer.

So, Both Statement-I and Statement-II are correct, and Statement-II explains Statement-I.


Quantum physics theorizes that empty space isn't actually empty.
Instead pairs of so-called virtual particles continuously arise out of the vacuum.
Virtual particle
Event horizon
Black hole
These pairs usually stay together and annihilate each other, except for the unlucky few that arise on either side of a black hole's boundary, called its event horizon.
Infalling radiation
In that case, one member of the pair can get trapped within the horizon ...
... while the other carries energy away.
Escaping radiation
Gravitional space distortion

ADDITIONAL INFORMATION:

BLACK HOLE	
How black hole was	➢ During a star's lifetime, it produces energy by fusing heavier and heavier elements in its core. ➢ Eventually, the star has no material left that can be transformed into energy, but what happens next depends on the size of the star.

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born?	➢ Stars up to about ten times the mass of the Sun expand to become red giants and then white dwarfs surrounded by planetary nebulas (which have nothing to do with planets). But larger stars with iron cores begin to collapse, starting with the innermost layers. ➢ When the outer layers fall onto this compact core, they bounce back and are expelled into space as a supernova. If the compact core that remains is more than three times the mass of the Sun, it is crushed into a smaller and smaller volume, its gravitational attraction increases, and its escape velocity becomes larger. Eventually a point is reached when even light cannot travel fast enough to escape which is how this black hole is formed.
Black hole mission	➢ Europeon Space agency currently operates two high-energy space observatories: XMM-Newton and Integral. ➢ The XMM-Newton X-ray observatory has helped scientists to investigate some of the most violent and mysterious cosmic phenomena, including the interaction of black holes with their surroundings. XMM-Newton has also explored the origin of powerful explosions known as gamma-ray bursts, which are thought to be caused by black holes. ➢ Integral –the International Gamma Ray Astrophysics Laboratory – is the first space observatory that can simultaneously observe objects in gamma rays, X-rays, and visible light. Its principal targets include gamma-ray bursts and regions in the Universe thought to contain black holes. Integral is helping us understand the black hole at the centre of the Milky Way, as well as those at the centres of other galaxies. ➢ ESA future missions will be LISA and Athen**.** Together, the duo could reveal much about distant and merging black holes, bright quasars in active galaxies, rapid jets around spinning black holes, the cosmic distance scale, and the speed of gravity.

48. Consider the following statements regarding Naegleria fowleri :
    1. It is a free-living amoeba or a single-celled living organism.
    2. It causes a rare contagious disease that affects the central nervous system.
    3. It is found at very low temperatures that are conducive to its growth and can survive for short periods in warm environments.

    Which of the statements given above is/are correct ?
    (a) **1 only**
    (b) 1 and 2 only
    (c) 1 and 3 only
    (d) 2 and 3 only

EXPLANATION:

Amoeba" is a term that describes a simple eukaryotic organism that moves in a characteristic crawling fashion. Free-living amoebae are protozoa that normally live in the environment and only occasionally infect human or animal hosts. It's considered a free-living organism because it doesn't need a host to live.
Free-living amoeba belonging to the genera Acanthamoeba, Balamuthia, Naegleria and Sappinia are rare causes of disease in humans and animals. Naegleria fowleri is an amoeba (type of one-celled organism) that thrives in warm freshwater lakes, rivers, and hot springs. **So, Statement 1 is correct.**

Naegleriafowleri is the most commonly seen species, causing central nervous system infection and disease. Naegleriafowleri is often called the "brain-eating amoeba" because it can infect the brain and destroy brain tissue. People who become infected by this amoeba develop a condition called primary amoebic meningoencephalitis (PAM).
PAM is a very serious infection of the central nervous system that's almost always fatal. Where trophozoites infect nasal tissues and sinuses of immune-competent hosts and travel up the olfactory nerve into the brain. Symptoms appear within 3-6 days and include headache, stiff neck, seizures, coma and death. Death occurs within 1-2 weeks of infection without treatment.
We cannot get a Naegleria fowleri infection from swallowing water containing the amoeba. We also can't get an infection from someone else or pass it on to others. Hence, It can cause rare brain infections but is not contagious. **So, Statement 2 is not correct.**

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The amoeba is found in warm and still freshwater bodies of water. Naegleriafowleri is found around the world, often in warm or hot freshwater (lakes, rivers, and hot springs). It is commonly found in lakes in southern-tier states but has caused infections in more northern states, including Minnesota. The amoeba grows best in warm or hot water. **So, Statement 3 is not correct.**

ADDITIONAL INFORMATION:

PRIMARY AMOEBIC MENINGOENCEPHALITIS	
Symptoms	Symptoms of PAM usually start about 5 days after infection. Symptoms can be mild at first but worsen very quickly. In its early stages, symptoms may include: ➢ Headache ➢ Fever ➢ Nausea ➢ Vomiting ➢ Later symptoms may include: ➢ Stiff neck ➢ Confusion ➢ Lack of attention to people and surroundings ➢ Loss of balance ➢ Seizures ➢ Hallucinations After symptoms begin, the disease can move quickly and cause death within about 5 days. People should seek medical care immediately whenever they have a sudden fever, headache, stiff neck, and vomiting - particularly if they have been in warm freshwater within the previous 2 weeks.
Preventive measures	The only sure way to prevent PAM is to avoid participation in freshwater-related activities. You can reduce the risk of PAM by limiting the amount of water going up the nose. When taking part in water-related activities in bodies of warm freshwater: ➢ Avoid warm freshwater when the water temperature is high, and the water level is low. ➢ Avoid putting your head under the water. ➢ Hold your nose shut or use nose clips. ➢ Avoid digging or stirring up the sediment

49. Consider the following rows with respect to Chandrayan 3 :

Sl. No.	***Payload***	***Placed In***	***Objective***
1.	Langmuir probe	Lander	To measure the near surface plasma density.
2.	Alpha Particle X-ray Spectrometer	Rover	To determine the element composition of lunar soil.
3.	LASER Retroreflector Array	Lander	to understand the dynamics of Moon system
4.	Spectro-polarimetry of HAbitable Planet Earth	Propulsion Module	Future discoveries of smaller planets

In How many of the above rows is the given information correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) **All four**

EXPLANATION:

A Langmuir probe is a specialized instrument used to measure the properties of plasmas, such as electron temperature and density, in the near-surface region of a planetary body or moon. As a lander, a Langmuir probe is designed to descend to the surface and collect data on the plasma environment in close proximity to the surface. **So, Row (1) is correct.**

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The Alpha Particle X-ray Spectrometer Rover is designed to determine the elemental composition of lunar soil. This instrument uses alpha particles and X-rays to analyze the chemical elements present in the soil samples. The process involves irradiating the sample with alpha particles, which causes the elements to emit characteristic X-rays. The APXS then detects and measures these X-rays to identify the elements present. APXS observations have discovered interesting minor elements, including Sulfur, apart from the major expected elements such as Aluminum, Silicon, Calcium, and Iron. **So, Row (2) is correct.**
The Laser Retroreflector Array (LRA) is designed to use reflected laser light from orbiting spacecraft laser (typically a laser altimeter or light detection and ranging - lidar) to precisely determine the location of the lander, as a fiducial marker and the distance to that point on the lunar surface with respect to the orbiter. In Chandrayan 3, it is placed in a lander as a passive experiment to understand the dynamics of the Moon system. **So, Row (3) is correct.**
SHAPE (Spectro-polarimetry of HAbitable Planet Earth) is an experimental payload onboard Chandrayaan-3 Mission for the study of spectro-polarimetric signatures of Earth in the near-infrared (NIR) wavelength range (1.0 – 1.7 μm). It is the only scientific payload on the Propulsion Module (PM) of the Chandrayaan-3 mission. The main objective is future discoveries of smaller planets in reflected light would allow us to probe into a variety of Exo-planets, which would qualify for habitability (or for the presence of life). **So, Row (4) is correct.**

ADDITIONAL INFORMATION:

OTHER PAYLOADS	
About	➢ Chandrayaan-3 consists of an Indigenous Lander module (LM), Propulsion module (PM) and a Rover to develop and demonstrate new technologies required for Interplanetary missions. ➢ The Lander will have the capability to soft land at a specified lunar site and deploy the Rover which will carry out in-situ chemical analysis of the lunar surface during the course of its mobility. ➢ The Lander and the Rover have scientific payloads to experiment on the lunar surface. ➢ The main function of the PM is to carry the LM from launch vehicle injection to the final lunar 100 km circular polar orbit and separate the LM from the PM. Apart from this, the Propulsion Module also has one scientific payload as a value addition which will be operated post-separation of the Lander Module. ➢ The launcher identified for Chandrayaan-3 is LVM3 M4, which will place the integrated module in an Elliptic Parking Orbit (EPO) of size ~170 x 36500 km.
Lander payloads	➢ Chandra's Surface Thermo physical Experiment (ChaSTE) • To carry out the measurements of thermal properties of the lunar surface near the polar region. ➢ Instrument for Lunar Seismic Activity (ILSA) • To measure seismicity around the landing site and delineating the structure of the lunar crust and mantle.
Rover payloads	➢ LASER Induced Breakdown Spectroscope (LIBS) • Qualitative and quantitative elemental analysis &To derive the chemical Composition and infer mineralogical composition to further our understanding of the Lunar surface.

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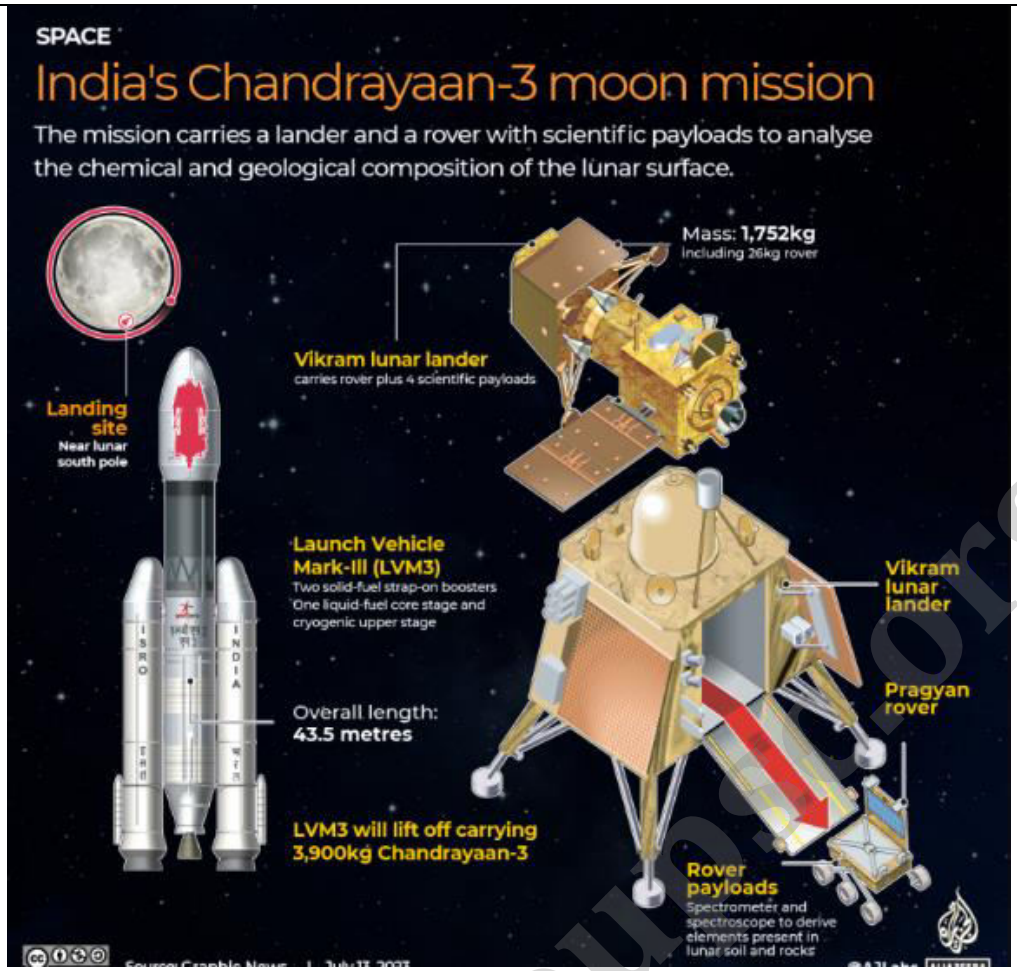
SPACE
India's Chandrayaan-3 moon mission
The mission carries a lander and a rover with scientific payloads to analyse the chemical and geological composition of the lunar surface.
Mass: 1,752kg
Including 26kg rover
Vikram lunar lander
carries rover plus 4 scientific payloads
Landing site
Near lunar south pole
Launch Vehicle Mark-III (LVM3)
Two solid-fuel strap-on boosters
One liquid-fuel core stage and cryogenic upper stage
Overall length: 43.5 metres
LVM3 will lift off carrying 3,900kg Chandrayaan-3
Vikram lunar lander
Pragyan rover
Rover payloads
Spectrometer and spectroscope to derive elements present in lunar soil and rocks

50. Consider the following statements with respect to GaganyaanMission :
    1. The development of first module of Bharatiya Anthariksh Station - India's Own Space Station is done under this mission.
    2. The CE20 cryogenic engine of ISRO is to be used in the Human Rated Launch Vehicle of Gaganyan Mission.
    3. After the human spaceflight, the Gaganauts will be landed back on the Landing Complex built at the Satish Dhawan Space Centre, Sriharikota.

    How many of the statements given above are correct ?

    (a) Only one
    (b) Only two
    (c) All three
    (d) None

EXPLANATION:

The government of India has approved the building of the first module of the country's space station, to be called Bharatiya Antariksh Station (BAS-1), by extending the scope of its Gaganyaan mission. The development marks an important milestone towards the operationalisation of India's own space station by 2035 and paves the way for a crewed moon mission by 2040. **So, Statement 1 is correct.**

ISRO has accomplished a major milestone in the human rating of its CE20 cryogenic engine that powers the cryogenic stage of the human-rated LVM3 launch vehicle for Gaganyaan missions, with the completion of the final round of ground qualification tests. The ground qualification tests for the human rating of the CE20 engine involved life demonstration tests, endurance tests, and performance assessment under nominal operating conditions as well as off-nominal conditions with respect to thrust, mixture ratio, and

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propellant tank pressure. All the ground qualification tests of the CE20 engine for the Gaganyaan programme have been successfully completed. **So, Statement 2 is correct.**

Gaganyaan project envisages demonstration of human spaceflight capability by launching crew of 3 members to an orbit of 400 km for a 3 days mission and bring them back safely to earth, by landing in Indian sea waters. The Gaganyaan mission plans to have the Gagannauts land in the Arabian Sea off the coast of Gujarat, after re-entering Earth's atmosphere. The ISRO team has planned every detail for a safe and successful recovery. So, it's not landing in Landing Complex built at The SatishDhawan Space Centre, Sriharikota. **So, Statement 3 is not correct.**

ADDITIONAL INFORMATION:

GAGANYAAN MISSION	
Recently in News	Indian Space Research Organisation (ISRO) said that efforts are being made to launch India's first human space flight program, Gaganyaan by the end of this year.
About	➢ The Gaganyaan project is accomplished through an optimal strategy by considering inhouse expertise, experience of Indian industry, intellectual capabilities of Indian academia & research institutions along with cutting edge technologies available with international agencies. ➢ The pre-requisites for Gaganyaan mission include development of many critical technologies including human rated launch vehicle for carrying crew safely to space, Life Support System to provide an earth like environment to crew in space, crew emergency escape provision and evolving crew management aspects for training, recovery and rehabilitation of crew. ➢ Various precursor missions are planned for demonstrating the Technology Preparedness Levels before carrying out the actual Human Space Flight mission. ➢ These demonstrator missions include Integrated Air Drop Test (IADT), Pad Abort Test (PAT) and Test Vehicle (TV) flights. ➢ Safety and reliability of all systems will be proven in unmanned missions preceding manned mission.
LVM3 - HLVM3	➢ LVM3 rocket - The well proven and reliable heavy lift launcher of ISRO, is identified as the launch vehicle for Gaganyaan mission. It consists of solid stage, liquid stage and cryogenic stage. ➢ All systems in LVM3 launch vehicle are re-configured to meet human rating requirements and christened Human Rated LVM3. ➢ HLVM3 will be capable of launching the Orbital Module to an intended Low Earth Orbit of 400 km. ➢ HLVM3 consists of Crew Escape System (CES) powered by a set of quick acting, high burn rate solid motors which ensures that Crew Module along with crew is taken to a safe distance in case of any emergency either at launch pad or during ascent phase.

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51. Consider the following statements :

Statement I :

The moon has no atmosphere on its own.

Statement II *:*

Since the radius and acceleration due to the gravity of the moon are small, the escape velocity of the moon is five times smaller than the Earth.

Select the correct answer using the code given below :

(a) **Both Statement I and Statement II are true and Statement II is the correct explanation of Statement I**.

(b) Both Statement I and Statement II are true, but Statement II is not the correct explanation of Statement I.

(c) Statement I is true but Statement II is false

(d) Statement I is false but Statement II is true.

EXPLANATION:

The Moon has no substantial atmosphere partly because it has a lower escape velocity compared to Earth. Escape velocity is the minimum speed needed for an object to break free from a celestial body's gravitational pull.

Since the Moon's escape velocity is only about 2.4 km/s (compared to Earth's 11.2 km/s), lighter gases can easily reach speeds that allow them to escape into space. This inability to retain gases contributes to the Moon's lack of a significant atmosphere. Thus, the combination of low gravity and lower escape velocity means that any atmospheric gases that might have been present can easily drift away into space, leaving the Moon with only a very thin exosphere. **So, Option (a) is correct.**

52. Which article of the Indian Constitution provides a constitutional safeguard ensuring that a person who is arrested shall not be detained without being informed of the grounds for arrest and shall not be denied the right to consult and be defended by a legal practitioner ? ?

(a) Article 21

(b) **Article 22**

(c) Article 24

(d) Article 25

EXPLANATION:

Article 22 grants protection to persons who are arrested or detained. The Detention is of two types, namely, punitive and preventive. Punitive Detention is to punish a person for an offence committed by him after trial and conviction in a court. Preventive Detention, on the other hand, means the Detention of a person without trial and conviction by a court.

Article 22 has two parts–the first part deals with the cases of ordinary law, and the second part deals with the cases of preventive detention law.

The first part of Article 22 confers the following rights on a person who is arrested or detained under an ordinary law:

- Right to be informed of the grounds of arrest.
- Right to consult and be defended by a legal practitioner.
- Right to be produced before a magistrate within 24 hours, including the journey time.
- Right to be released after 24 hours unless the magistrate authorises further Detention.

These safeguards are not available to an enemy alien or a person arrested or detained under a preventive detention law. The Supreme Court also ruled that the arrest and Detention in the first part of Article 22 do not cover arrest under the orders of a court, civil arrest, arrest on failure to pay the income tax, and deportation of an alien. They apply only to an act of a criminal or quasi-criminal nature or some activity prejudicial to the public interest.

So, Option (b) is correct.

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ADDITIONAL INFORMATION:

ARTICLES	
ARTICLE 21	➢ Article 21 declares that no person shall be deprived of his life or personal liberty except according to procedure established by law. This right is available to both citizens and non-citizens. ➢ The Supreme Court declared the following rights as part of Article 21: ▪ Right to live with human dignity. ▪ Right to a decent environment, pollution-free water and air and protection against hazardous industries. ▪ Right to livelihood. ▪ Right to privacy. ▪ Right to shelter. ▪ Right to health. ▪ Right to free education up to 14 years of age. ▪ Right to free legal aid. ▪ Right against solitary confinement. ▪ Right to a speedy trial. ▪ Right against handcuffing. ▪ Right against inhuman treatment, etc.
ARTICLE 24	Article 24 prohibits the employment of children below the age of 14 years in any factory, mine or other hazardous activities like construction work or railway. But it does not prohibit their employment in any harmless or innocent work.
ARTICLE 25	➢ Freedom of Conscience and Free Profession, Practice and Propagation of Religion. ➢ Article 25 says that all persons are equally entitled to freedom of conscience and the right to freely profess, practice and propagate religion.

53. Consider the following statements with reference to a mirage :
    1. The refractive index of air decreases with its density.
    2. In colder regions, Objects appear to be elevated or floating above the horizon during mirage.
    3. Mirages can be observed in hot deserts and travelling on a vehicle during hot summers.

    How many of the above statements are correct?

    (a) Only one
    (b) Only two
    (c) All three
    (d) None

EXPLANATION:

Mirage, in optics, is the deceptive appearance of a distant object or objects caused by the bending of light rays (refraction) in layers of air of varying density. On hot summer days, the air near the ground becomes hotter than the air at higher levels. The refractive index of air increases with its density. Hotter air is less dense and has a smaller refractive index than cooler air. **So, Statement 1 is not correct**

A superior mirage or looming occurs when there is a temperature inversion; the air below the line of sight is colder than the air above it. Passing through the temperature inversion, the light rays are bent down, and so the image appears above the true object, hence the name superior. Most superior mirages tend to be stable, as cold air has no tendency to move up and warm air has no tendency to move down. Superior mirages can make objects below the horizon visible at least in some form or distort the image of an object at the horizon. **So, Statement 2 is not correct.**

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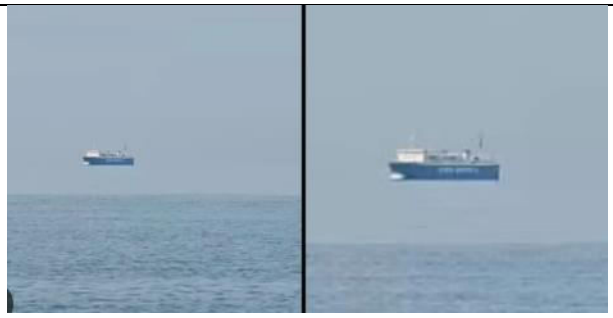

Mirage is especially common in hot deserts. Mirage is an optical illusion which is observed in deserts or on tarred roads in hot summer days. This creates an illusion of water, which actually is not there. While moving in a bus or a car during a hot summer day, a distant patch of road, especially on a highway, appears to be wet. But, do not find any evidence of wetness when reach that spot. This is due to mirage. **So, Statement 3 is correct.**

ADDITIONAL INFORMATION:

INTERNAL REFLECTION	
About	➢ When light travels from an optically denser medium to a rarer medium at the interface, it is partly reflected back into the same medium and partly refracted to the second medium. This reflection is called the internal reflection. ➢ When light gets reflected by a surface, normally some fraction of it gets transmitted. The reflected ray, therefore, is always less intense than the incident ray, howsoever smooth the reflecting surface may be. In total internal reflection, on the other hand, no transmission of light takes place.
Total internal reflection in nature	The following are the Total internal reflection in Nature and its technological Applications: ➢ Mirage: • Inverted images of distant tall objects cause an optical illusion to the observer. ➢ Diamond: • Diamonds are known for their spectacular brilliance. Their brilliance is mainly due to the total internal reflection of light inside them. • The critical angle for diamond-air interface (≅ 24.4°) is very small, therefore once light enters a diamond; it is very likely to undergo total internal reflection inside it. • Diamonds found in nature rarely exhibit the brilliance for which they are known. • It is the technical skill of a diamond cutter which makes diamonds to sparkle so brilliantly. • By cutting the diamond suitably, multiple total internal reflections can be made to occur.

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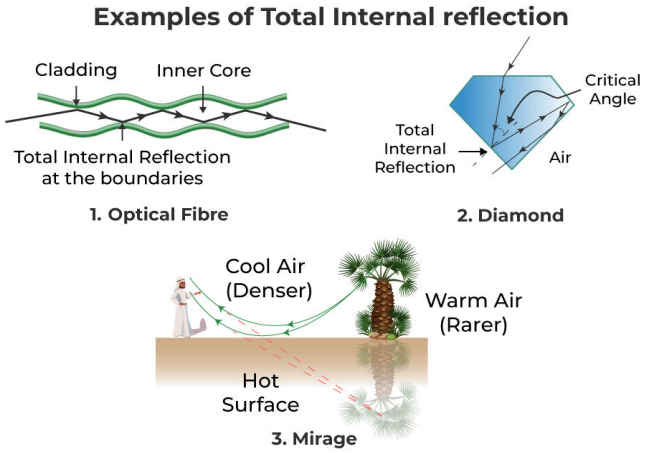
	➢ Prism ➢ Optical Fibre 

54. Consider the following :

"It is a collective network of connected devices and the technology that facilitates communication between devices and the cloud and between the devices themselves. It allows them to collect and share data. Centres of Excellence have been established for this network at Bengaluru, Gurugram and Gandhi Nagar."

The statements given above describe which of the following technologies ?

(a) Block Chain Technology
(b) Internet of Things
(c) Metaverse
(d) Augmented Reality

EXPLANATION:

The above description is about the Internet of Things, which refers to the collective network of connected devices and the technology that facilitates communication between devices and the cloud and between the devices themselves, allowing them to collect and share data.

- Under the Digital India initiatives, MeitY, along with NASSCOM and state governments, has set up Centres of Excellence on Internet of Things at Bengaluru, Gurugram, Gandhi Nagar and Visakhapatnam.
- The first centre on the Internet of Things was established in Bengaluru in the Year 2016 along with Govt of Karnataka and NASSCOM.
- One of the objectives of these centres is to enable India to emerge as an innovation hub in IoT through the democratization of innovation and the realization of prototypes.

Centres of Excellence on IoT connect various entities, such as startups, enterprises, venture capitalists, government and academia. They enable startups in the areas of IoT, Big Data, Augmented Reality/Virtual Reality, Artificial Intelligence and Robotics to reach their maximum potential. **So, Option (b) is correct.**

ADDITIONAL INFORMATION:

EMERGING TECHNOLOGIES	
Big Data	➢ With technology making inroads into almost every sphere of our lives, data is being produced at a colossal rate. Today, there are over a billion Internet users, and a majority of the world's web traffic is coming from smartphones. ➢ At the current pace, around 2.5 quintillion bytes of data are created each day, and the pace is increasing with the continuous evolution of the Internet of Things (IoT). This results in the generation of data sets of enormous volume and complexity called Big Data.

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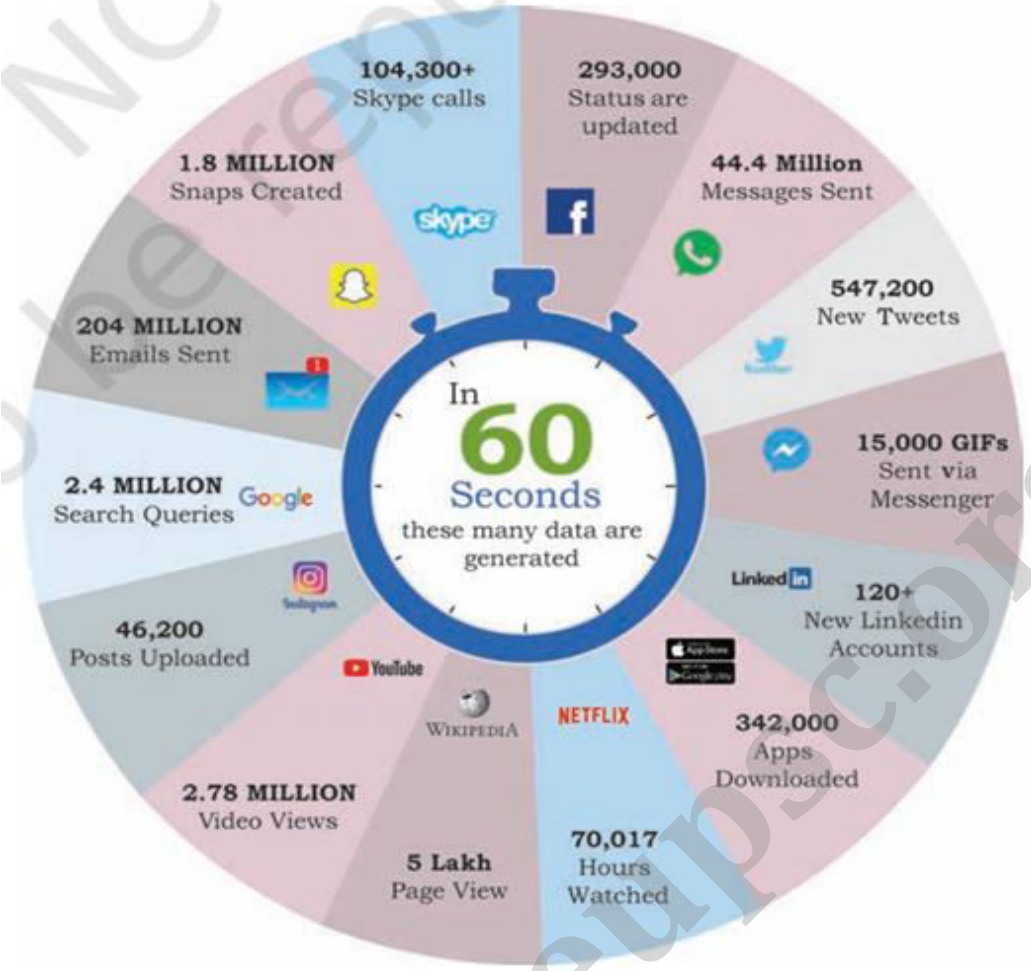

Figure 2.8: Sources of big data (numbers are approximate)

Internet of Things

The 'Internet of Things' is a network of devices that have embedded hardware and software to communicate (connect and exchange data) with other devices on the same network.

- At present, in a typical household, many devices have advanced hardware (microcontrollers) and software. These devices are used in isolation from each other, with maximum human intervention needed for operational directions and input data.
- IoT tends to bring together these devices to collaborate and assist each other in creating an intelligent network of things.
- For example, suppose a microwave oven, an air conditioner, a door lock, a CCTV camera or other such devices are enabled to connect to the Internet. In that case, we can access and remotely control them on the go using our smartphone.

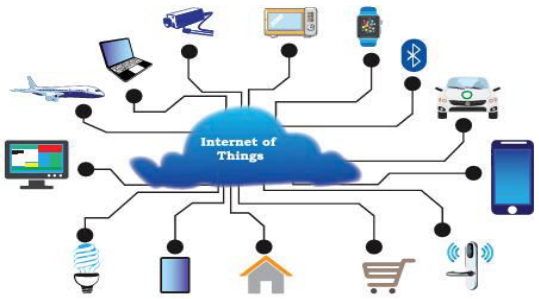

Figure 2.10: Internet of Things (IoT)

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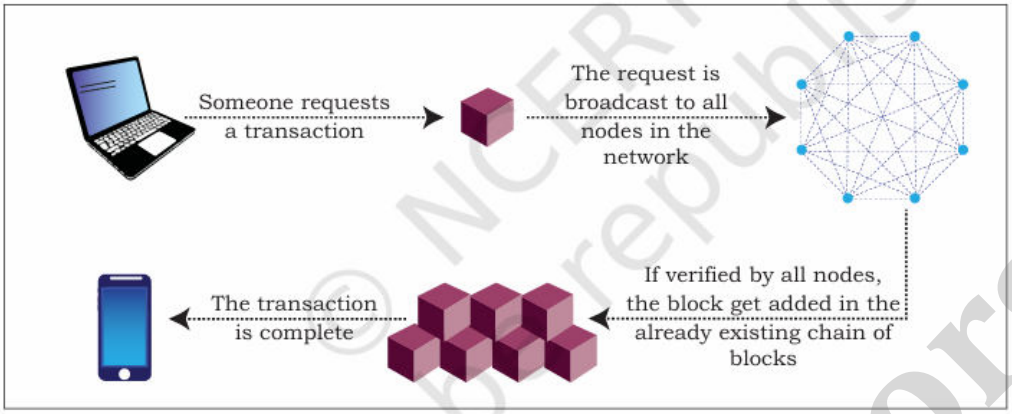
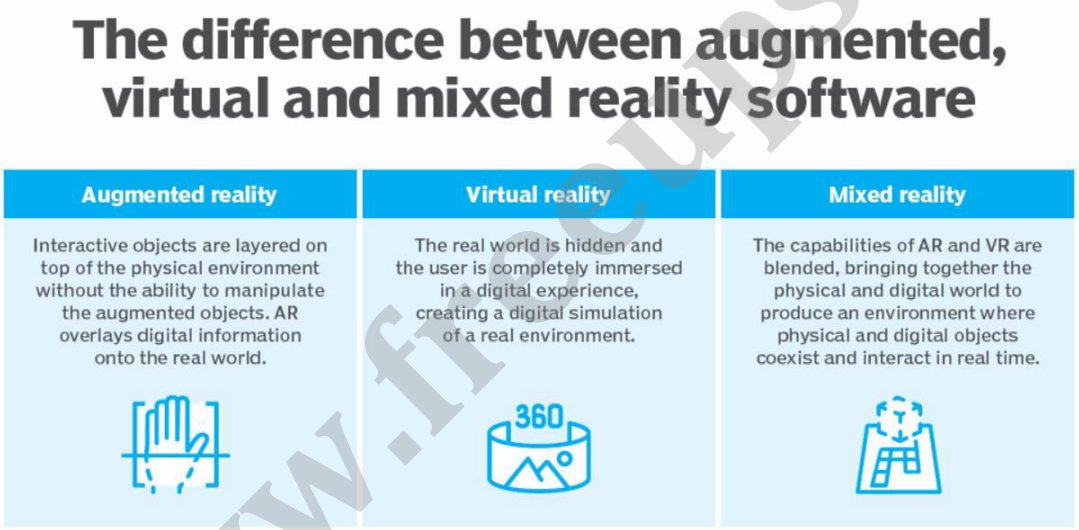
Block Chain Technology	➢ Blockchain technology works on the concept of a decentralized and shared database where each computer has a copy of the database. ➢ A block can be thought of as a secured chunk of data or a valid transaction. ➢ Each block has some data called its header, which is visible to every other node, while only the owner has access to the private data of the block. Such blocks form a chain called a blockchain.  *Figure 2.14: Block chain technology*
Metaverse	➢ The Metaverse refers to the convergence of physical and virtual space accessed through computers and enabled by immersive technologies such as virtual, augmented, and mixed reality. 

55. Consider the following statements with respect to Quantum Key Distribution :
    1. Quantum key distribution utilises the properties of quantum mechanics to develop a secure dedicated communications link.
    2. In Public key encryption of messages, the same key is used to encrypt and decrypt the message.
    3. In Private key encryption of messages, two different keys are used to encrypt and decrypt the message.

    How many of the statements given above are correct ?

    (a) Only one
    (b) Only two
    (c) All three
    (d) None

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EXPLANATION:

Quantum key distribution utilizes the unique properties of quantum mechanical systems to generate and distribute cryptographic keying material using special purpose technology. QKD is a method of distributing quantum-safe encryption keys between parties, and it's the backbone of quantum-secure networks. Rather than mathematics, it uses the quantum properties of light to generate secure random keys for encrypting and decrypting data, ensuring QKD-protected transmissions can never be intercepted and decrypted by adversaries.

QKD works by transmitting many light particles, *or photons,* over fiber optic cables between parties. Each photon has a random quantum state, and collectively, the photons sent make up a stream of ones and zeros. This stream of ones and zeros are called qubits -- the equivalent of bits in a binary system.**So, Statement 1 is correct.**

All encryption systems rely on the concept of a key. A key is the basis for a transformation, usually mathematical, of an ordinary message into an unreadable message. For centuries, most encryption systems have relied on private key encryption. Public key encryption is the only challenge to private key encryption that has appeared in the last 30 years.

Private key encryption systems use a single key that is shared between the sender and the receiver. Both must have the key; the sender encrypts the message by using the key, and the receiver decrypts the message with the same key. Both the sender and receiver must keep the key private to keep their communication private. This kind of encryption has characteristics that make it unsuitable for widespread general use:

- Private key encryption requires a key for every pair of individuals who need to communicate privately. The necessary number of keys rises dramatically as the number of participants increases.
- Keys must be shared between pairs of communicators, therefore the keys must be distributed to the participants. The need to transmit secret keys makes them vulnerable to theft.
- Participants can communicate only by prior arrangement. You cannot send a usable encrypted message to someone spontaneously. You and the other participant must make arrangements to communicate by sharing keys.

Private key encryption is also called symmetric encryption because the same key is used to encrypt and decrypt the message. **So, Statement 2 is not correct.**

Public key encryption uses a pair of mathematically related keys. A message that is encrypted with the first key must be decrypted with the second key, and a message that is encrypted with the second key must be decrypted with the first key.

Each participant in a public key system has a pair of keys. One key is nominated as the private key and is kept secret. The other key is distributed to anyone who wants it; this key is the public key.

Anyone can encrypt a message by using your public key, but only you can read it. When you receive the message, you decrypt it by using your private key.

This kind of encryption has characteristics that make it very suitable for general use:

- Public key encryption requires only two keys per participant.
- The need for secrecy is more easily met: only the private key needs to be kept secret, and because it does not need to be shared, it is less vulnerable to theft in transmission than the shared key in a symmetric key system.
- Public keys can be published, which eliminates the need for prior sharing of a secret key before communication. Anyone who knows your public key can use it to send you a message that only you can read.

Public key encryption is also called asymmetric encryption because the same key cannot be used to encrypt and decrypt the message. Instead, one key of a pair is used to undo the work of the other. **So, Statement 3 is not correct.**

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56. Consider the following statements regarding Asset Reconstruction Companies :
    1. It is a financial institution that buys non-performing assets or bad assets from banks and financial institutions to clean their balance sheets.
    2. National Asset Reconstruction Company Limited (NARCL) is a government entity registered with the Reserve Bank of India as an Asset Reconstruction Company.

    Which of the above statements is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) **Both 1 and 2**
    (d) Neither 1 nor 2

EXPLANATION:

An Asset Reconstruction Company (ARC) is a financial institution that buys Non-Performing Assets (NPA) or bad assets from banks and financial institutions so that the latter can clean up their balance sheets. ARCs play a critical role in the resolution of stressed financial assets of banks and financial institutions, thereby enhancing the overall health of the financial system. **So, Statement 1 is correct.**

In the Union Budget 2021, the Government of India announced the formation of an Asset Reconstruction Company and Asset Management Company (ARC-AMC) structure comprising two entities viz. National Asset Reconstruction Company Limited (NARCL) and India Debt Resolution Company Limited (IDRCL) for aggregation and resolution of Non-Performing Assets (NPAs) in the Banking Industry.
National Asset Reconstruction Companies Limited (NARCL) is a government entity incorporated in July 2021 with a majority stake held by Public Sector Banks and balance by private banks, with Canara Bank being the sponsor bank. It is registered with the Reserve Bank of India as an Asset Reconstruction Company under the Securitisation and Reconstruction of Financial Assets and Enforcement of Security Interest Act, 2002.
IDRCL is a service company/operational entity which will manage the asset and engage market professionals and turnaround experts. Public Sector Banks (PSBs) and Public Financial Institutions (Fis) will hold a maximum of 49% stake and the rest will be with private sector lenders. **So, Statement 2 is correct**.

ADDITIONAL INFORMATION:

ASSET RECONSTRUCTION COMPANY(ARC)	
About	➢ Asset Reconstruction Companies in India take care of stressed banks' Non-Performing Assets (NPAs). ARCs in India have been set up by state-owned and private-sector banks. Also, there is no equity contribution from the government. ➢ ARCs help banks clean up their balance sheets by acquiring financial assets from banks and financial institutions through auctions or bilateral negotiations. ➢ They securitize and reconstruct the assets to bring liquidity into the system. ➢ The Reserve Bank of India, being the regulator of Asset Reconstruction Companies (ARCs), has already prescribed a regulatory framework for the functioning of ARCs, and there are well-laid norms for transferring stressed assets by banks and non-banking finance companies to ARCs.

57. With respect to Huygens's principle, consider the following statements :
    1. Waves from a point source spread out in all directions while light travel along narrow rays.
    2. The limit of the ability of microscopes and telescopes to distinguish very close objects is set by the wavelength of light.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

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EXPLANATION:

When small stone is dropped in pool of water, waves spread out from the point of impact. Every point on the surface starts oscillating with time. At any instant, a photograph of the surface would show circular rings on which the disturbance is maximum. Clearly, all points on such a circle are oscillating in phase because they are at the same distance from the source. Such a locus of points, which oscillate in phase is called a wavefront. If we have a point source emitting waves uniformly in all directions, then the locus of points which have the same amplitude and vibrate in the same phase are spheres and we have what is known as a spherical wave. From this we can infer that waves from a point source spread out in all directions.

Huygens' postulated that light is a wave, which travels through a hypothetical medium called ether. This hypothetical medium has the strange property of occupying all space, including vacuum. Light was seen to travel along narrow rays. The vibrations from the source of light propagate in the form of waves and the energy carried by them is distributed equally in all directions. **So, Statement 1 is correct**.

If we look clearly at the shadow cast by an opaque object, close to the region of geometrical shadow, there are alternate dark and bright regions just like in interference. This happens due to the phenomenon of diffraction. Diffraction is a general characteristic exhibited by all types of waves, be it sound waves, light waves, water waves or matter waves. Since the wavelength of light is much smaller than the dimensions of most obstacles; we do not encounter diffraction effects of light in everyday observations. However, the finite resolution of our eye or of optical instruments such as telescopes or microscopes is limited due to the phenomenon of diffraction. **So, Statement 2 is correct**.

58. Consider the following statements regarding the classification of missiles :
    1. On the basis of propulsion, Aluminum powder is used as solid fuel and hydrocarbons are used in liquid propulsion technology.
    2. In the wire guidance system, the command signals are passed along a wire dispensed from the missile while in the Inertial guidance, accelerometers are used in control systems.

    Which of the statements given above is/are correct ?

    (a) 1 only
    (b) 2 only
    (c) **Both 1 and 2**
    (d) Neither 1 nor 2

EXPLANATION:

Solid Propulsion: Solid fuel is used in solid propulsion. Generally, the fuel is aluminum powder. Solid propulsion has the advantage of being easily stored and can be handled in fuelled condition. It can reach very high speeds quickly. Its simplicity also makes it a good choice whenever large amount of thrust is needed.

Liquid Propulsion: The liquid propulsion technology uses liquid as fuel. The fuels are hydrocarbons. The storage of missile with liquid fuel is difficult and complex. In addition, preparation of missile takes considerable time. In liquid propulsion, propulsion can be controlled easily by restricting the fuel flow by using valves and it can also be controlled even under emergency conditions. Basically, liquid fuel gives high specific impulse as compared to solid fuel. **So, Statement 1 is correct.**

Wire Guidance system is broadly similar to radio command, but is less susceptible to electronic counter measures. The command signals are passed along a wire (or wires) dispensed from the missile after launch.

Inertial Guidance system is totally contained within the missile and is programmed prior to launch. Three accelerometers, mounted on a platform space-stabilised by gyros, measure accelerations along three mutually perpendicular axes, these accelerations are then integrated twice, the first integration giving velocity and the second giving position. The system then directs the control system to preserve the pre-programmed trajectory. These systems are used in the surface-to-surface missiles and in cruise missiles. **So, Statement 2 is correct.**

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ADDITIONAL INFORMATION:

CLASSIFICATION OF MISSILES	
About	**Missile**, a rocket-propelled weapon designed to deliver an explosive warhead with great accuracy at high speed. Missiles vary from small tactical weapons that are effective out to only a few hundred feet to much larger strategic weapons that have ranges of several thousand miles. Missiles are generally classified on the basis of their Type, Launch Mode, Range, Propulsion, Warhead and Guidance systems. ➢ Type: • Cruise Missile • Ballistic Missile ➢ Launch Mode: • Surface-to-Surface Missile • Surface-to-Air Missile • Surface (Coast)-to-Sea Missile • Air-to-Air Missile • Air-to-Surface Missile • Sea-to-Sea Missile • Sea-to-Surface (Coast) Missile • Anti-Tank Missile ➢ Range: This type of classification is based on maximum range achieved by the missiles. The basic classification is as follows: • Short Range Missile • Medium Range Missile • Intermediate Range Ballistic Missile • Intercontinental Ballistic Missile ➢ Propulsion: • Solid Propulsion • Liquid Propulsion • Hybrid Propulsion • Short & Long range Ballistic • Ramjet • Scramjet • Cryogenic ➢ Warhead: • Conventional • Strategic ➢ Guidance Systems: • Wire Guidance • Command Guidance • Terrain Comparison Guidance • Terrestrial Guidance • Inertial Guidance • Beam Rider Guidance • Laser Guidance • RF and GPS Reference- (RF- Radio frequency) and (GPS- Global Positioning System)

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59. Consider the following statements with respect to NISAR Mission :
    1. It is the first Low Earth Orbit observatory being jointly developed by NASA and ISRO.
    2. It contains high frequency S-Band radar developed by ISRO to obtain a high-resolution data on surface deformation on earth.
    3. The High-rate Science Downlink System and GPS receivers of the mission are to be indigenously developed by ISRO.

    Which of the statements given above are ***not*** correct ?

    (a) 1 only
    (b) 1 and 2 only
    (c) 3 only
    (d) 2 and 3 only

EXPLANATION:

NASA-ISRO Synthetic Aperture Radar (NISAR) is the first Low-Earth Orbit observatory jointly developed by NASA and ISRO.It is a joint Earth-observing mission between NASA and the Indian Space Research Organization (ISRO). The goal is to make global measurements of the causes and consequences of land surface changes using advanced radar imaging to monitor changing ecosystems, dynamic surfaces and ice masses. **So, Statement 1 is correct.**
NISAR has two Synthetic Aperture Radars (SARs) onboard, an L-band (L-SAR) and an S-band (S-SAR), and will be the first satellite to use two different radar frequencies. Both frequencies penetrate clouds and forest canopies, although the lower L-band frequencies can penetrate thicker vegetation, so the Earth's surface can be monitored independently of coverage. As such, the L-SAR will be used to observe landscape topography and heavily forested areas. The higher S-band frequencies will be used to monitor soil moisture, particularly in polar regions, as S-band frequencies are less perturbed by the ionosphere. Both radars operate with the Sweep SAR technique to achieve large swaths with high-resolution data. **So, Statement 2 is correct.**
NASA is responsible for providing the L-Band SAR payload system in which the ISRO supplied the S-Band SAR payload, and both these SAR systems will make use of a large size (about 12m diameter) common unfurlable reflector antenna. In addition, NASA would provide engineering payloads for the mission, including a Payload Data Subsystem, a High-rate Science Downlink System, GPS receivers and a Solid-State Recorder. ISRO is providing the spacecraft and launch vehicle and the S-band SAR electronics to be mounted on the instrument structure. **So, Statement 3 is not correct.**

ADDITIONAL INFORMATION:

NISAR	
About	➢ NISAR is a joint NASA-ISRO (Indian Space Research Organization) Earth-observing mission with the goal to make global measurements of the causes and consequences of land surface changes. ➢ Potential areas of research include ecosystem disturbances, ice sheet collapse and natural hazards. The NISAR mission is optimized to measure subtle changes of the Earth's surface associated with motions of the crust and ice surfaces. NISAR will improve our understanding of key impacts of climate change and advance our knowledge of natural hazards. NISAR will be the first satellite mission to use two different radar frequencies (L-band and S-band) to measure changes in our planet's surface less than a centimeter across. This allows the mission to observe a wide range of changes, from the flow rates of glaciers and ice sheets to the dynamics of earthquakes and volcanoes.

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Mission Capabilities	NISAR has two Synthetic Aperture Radars (SARs) onboard, an L-band (L-SAR) and an S-band (S-SAR), and will be the first satellite to use two different radar frequencies. Both frequencies penetrate clouds and forest canopies, although the lower L-band frequencies can penetrate thicker vegetation so the Earth's surface can be monitored independently of coverage. As such the L-SAR will be used to observe landscape topography and heavily forested areas. The higher S-band frequencies will be used to monitor soil moisture, particularly in polar regions as S-band frequencies are less perturbed by the ionosphere.

60. The World Economic Situation and Prospects (WESP) 2024 report was released by :
    (a) World Bank
    (b) **United Nations**
    (c) International Monetary Fund
    (d) Organization for Economic Co-operation and Development

EXPLANATION:

The World Economic Situation and Prospects 2023 is a report produced by the United Nations Department of Economic and Social Affairs (UN DESA), in partnership with the United Nations Conference on Trade and Development (UNCTAD) and the five United Nations regional commissions: Economic Commission for Africa (UNECA), Economic Commission for Europe (UNECE), Economic Commission for Latin America and the Caribbean (UNECLAC), Economic and Social Commission for Asia and the Pacific (UNESCAP) and Economic and Social Commission for Western Asia (UNESCWA). The United Nations World Tourism Organization (UNWTO) also contributed to the report.

- This report projects global economic growth to further slow down from an estimated 2.7% in 2023 to 2.4% in 2024, continuing to trend below the pre-pandemic growth rate of 3%. The report calls for stronger international cooperation to stimulate growth and promote green transition.
- This report shows that India's economy is now forecast to grow by 6.9% in 2024. This is an increase from the earlier projection of 6.2% made in January. The report also predicts a growth rate of 6.6% for 2025, which remains unchanged from the previous forecast.
- India's economy is forecast to expand by 6.9% in 2024 and 6.6% in 2025, mainly driven by strong public investment and resilient private consumption. Although subdued external demand will continue to weigh on merchandise export growth, pharmaceuticals and chemicals exports are expected to expand strongly.
- In addition to the growth projection, the UN report mentions a slowdown in consumer price inflation from 5.6% in 2023 to 4.5% in 2024. This expected decrease aligns with the Reserve Bank of India's (RBI's) target range of 2-6%.
- The labour market in India has also shown improvement, supported by economic growth and higher labour force participation. **So, Option (b) is correct.**

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ADDITIONAL INFORMATION:

REPORTS IN NEWS	
World Bank	➢ Global Economic Prospects Report ➢ World development report ➢ India development update ➢ Global Financial Development Report ➢ Logistics performance index ➢ Poverty and Shared Prosperity Report ➢ Groundswell report ➢ Global Human Capital Index ➢ Women, Business and the Law Report ➢ Digital Progress And Trends Report, 2023 ➢ Commodity Markets Outlook ➢ Ease of doing business (discontinued since 2021)
International Monetary Fund	➢ Global Financial Stability Report (biannual) ➢ International Monetary Fund (IMF) ➢ World Economic Outlook (biannual) ➢ Regional Economic Outlook ➢ Fiscal Monitor Report (biannual) ➢ External Sector Report (annual)
Organization for Economic Cooperation and Development	➢ The Programme for International Student Assessment (PISA) (test once in 3 years) ➢ Organization of Economic Cooperation and Development (OECD) ➢ Social Institutions and Gender Index (SIGI) ➢ Development Cooperation Report ➢ Anti-Corruption and Integrity Outlook 2024

61. Consider the following statements with respect to WEB 5.0 :
    1. It adds the feature of emotional intelligence to the internet.
    2. It provides complete control for the users to their data.
    3. It incorporates the semantic capabilities provided by Web 3.0.

    Which of the statement(s) given above is/are correct ?
    (a) 1 and 2 only
    (b) 1 and 3 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

EXPLANATION:

Web 5.0 is intended to be a decentralised web platform allowing developers to build decentralised web applications with verifiable credentials and nodes. This platform aims to reclaim proprietorship and control over user data.

Web 5.0 will be a combination of Web 2.0 and Web 3.0, emphasizing the creation of a web that is not only intelligent but also emotional. This entails the ability to communicate directly with its users, just as individuals do.

Web 5.0 adds emotional intelligence to the internet with the help of blockchain, AI, and deep learning so that Web 5.0 can interpret data itself with logic and give much more efficient output.

Web 5.0 allows users to own their identity on the internet and control their data. It will focus on delivering a better user experience while maintaining privacy. **So, Statements 1 and 2 are correct.**

Web 3.0 is also known as the Semantic Web. The Semantic Web improves web technologies' abilities to generate, share and connect content through search and analysis by understanding the meaning of words rather than by keywords or numbers.

Web 5.0 combines the best of Web 2.0 (characterised by greater user interactivity and collaboration) and

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Web 3.0 while taking the semantic Web to the next level and supporting global media connection. **So, Statement 3 is correct.**

ADDITIONAL INFORMATION:

DIFFERENT GENERATIONS OF INTERNET

Web 1.0	Web 2.0	Web 3.0	Web 5.0
It is known as the shopping carts and static Web.	It is also called the writing and participating Web.	It has been given the name of semantic Web.	It is called the open, linked and intelligent Web.
It was introduced for the sake of file storage and maintaining records.	It introduced the concept of staying interconnected with the world and was the starting point of social media.	It introduced the decentralisation of the internet and promoted the idea of giving back data control to the users.	This version of the internet promoted decentralisation to the next level. It even added emotional intelligence to the internet, making it much more efficient and logical.
There was no active communication and flow of data from the user side.	The flow of data from the user side started here and an active communication channel was set up.	It took communication to the next level with the introduction of a virtual world and blockchain technology.	Emotional intelligence in the internet along with real time connection globally are the central ideas of this version of internet.
There was no breach of user data.	User data was collected by the tech giants and used according to their preference.	Decentralization was introduced but the verification of information was still done by the nodes of a network.	Completely decentralized and transparent form of the internet. It makes sure that complete control of user data is with them only.

62. Consider the following statements :
    1. Positronium is a fundamental atomic system comprising baryons and leptons.
    2. Electrons and Positrons interact through electromagnetic and weak forces.

    Which of the statements given above is/are ***not*** correct ?
    (a) **1 only**
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

EXPLANATION:

Positronium (Ps) is a fundamental atom that comprises an electron (e^-) and a positron (e^+). Electrons and positrons are leptons. They interact through electromagnetic and weak forces.
A usual atom is made up of a mixture of baryons and leptons. Since Positronium is only made up of electrons and positrons and is not usually nuclear matter, it has the unique distinction of being a purely leptonic atom.
Matter is made up of electrons, protons and neutrons. Antimatter is made up of positrons, antiprotons and antineutrons. But Positronium comprises an electron (Matter) and a positron (Antimatter).

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For the first time, an international collaboration of researchers has successfully demonstrated the laser cooling of Positronium. This short-lived hydrogen-like atom provides an ideal testing ground for bound-state quantum electrodynamics.
The Antihydrogen Experiment: Gravity, Interferometry, Spectroscopy (AEgIS) collaboration has performed complex experiments at the European Organization for Nuclear Research (CERN) to obtain this breakthrough.
A Professor from Raman Research Institute (RRI), an autonomous institute of the Department of Science and Technology (DST) of the Government of India, is part of the AEgIS collaboration that comprises physicists from 19 European groups and one Indian group.
The results could pave the way for advanced studies leading to an improved understanding of the physical nature, comprising matter and antimatter facilitated through the interactions between light and charged matter. **So, Statement 1 is not correct, and Statement 2 is correct.**

63. Which of the following atmospheric phenomena is caused when a vertical beam of light appears to extend above and/or below a light source that develops as a result of ice crystals slowly falling through the air reflecting the sun's rays ?
    (a) Halos
    (b) Aurora
    (c) Sundogs
    (d) **Sun Pillars**

EXPLANATION:

A halo is a ring or light that forms around the sun or moon as the sun or moonlight refracts off ice crystals present in a thin veil of cirrus clouds. The halo is usually seen as a bright, white ring, although sometimes it can have colour. **So, Option (a) is not correct.**

Aurora is a Luminous upper atmosphere phenomenon that occurs primarily at high latitudes. Auroras in the Northern Hemisphere are called aurora borealis, or northern lights; in the Southern Hemisphere, they are called aurora australis, or southern lights.
Auroras are caused by the interaction of energetic particles (electrons and protons) from outside the atmosphere with atoms of the upper atmosphere. Such interaction occurs in zones surrounding the Earth's magnetic poles. During intense solar activity, auroras occasionally extend to the middle latitudes. **So, Option (b) is not correct.**

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Sundogs are coloured spots of light that develop due to the refraction of light through ice crystals. They are located approximately 22 degrees from the sun, either left, right, or both, depending on where the ice crystals are present. The colours usually go from red closest to the sun to blue outside the sundog. Sundogs are also known as mock suns or parhelia, which means "with the sun".

So, Option (c) is not correct.

Sun Pillars appear as a shaft of light extending vertically above the sun, often at sunrise or sundown. They develop due to ice crystals slowly falling through the air, reflecting the sun's rays off of them. Sun pillars are observed when the sun is low on the horizon and cirrus clouds are present. **So, Option (d) is correct.**

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64. Consider the following statements regarding the World Wildlife Crime Report, 2024 :
    1. The Report focuses on trends in the illegal trade and assesses the causes and impacts of wildlife trafficking and associated crime globally.
    2. Based on seizure records, Coral pieces are the most frequently traded illegal item followed by live specimens like ornamental plants.
    3. The Report was released by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

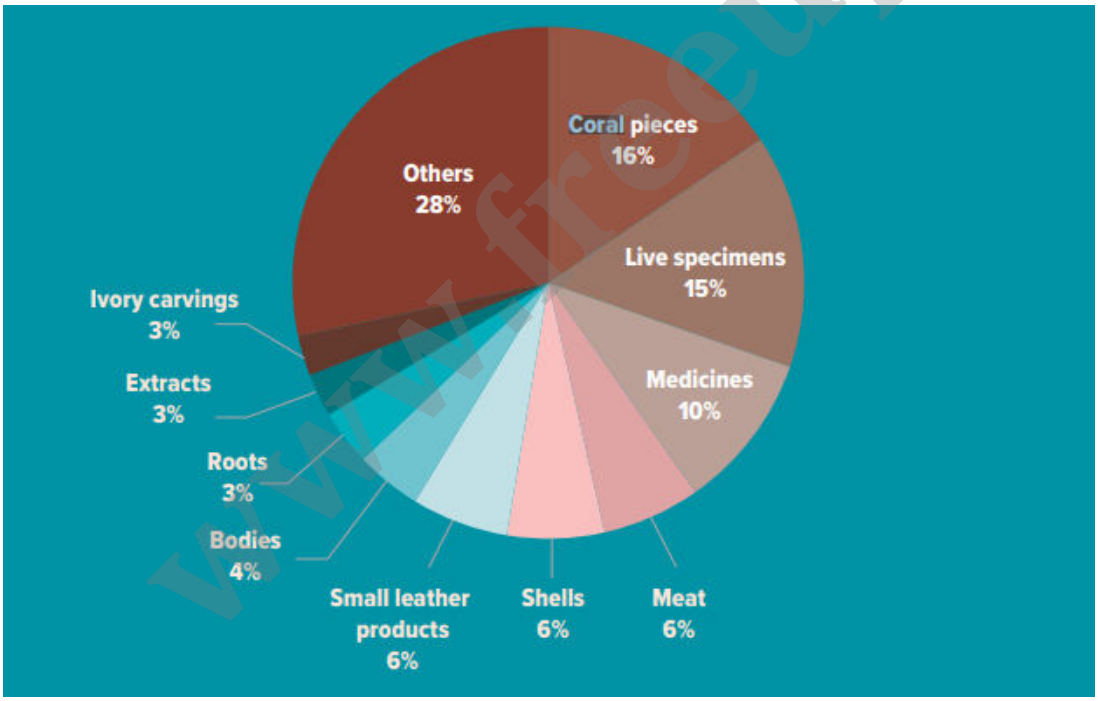
    Which of the statements given above are correct ?

    (a) **1 and 2 only**
    (b) 2 and 3 only
    (c) 1 and 3 only
    (d) 1, 2 and 3

EXPLANATION:

The World Wildlife Crime Report 2024 was launched On May 14, 2024, by the United Nations Office on Drugs and Crime (UNODC) in Vienna, Austria. This is the third Report in a series following the 2020 and 2016 publications. The Report provides an updated focus on trends in the illegal trade in wildlife species listed in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
This edition of the World Wildlife Crime Report probes recent trends in the illicit trafficking of protected wild fauna and flora species. It provides a broad assessment of current knowledge about the causes and implications of associated crime at a global level. **So, Statement 1 is correct.**

As Per the Report, during the period 2015–2021, based on the number of seizure records, coral pieces were the most frequently reported item in the illegal wildlife trade, followed by live specimens, which are generally part of the pet or ornamental plant trades although may also be used in medical research (e.g. monkeys) or processing into other products, like meat. Medicines, meat, shells and small leather products followed them. Roots and extracts were also prominent in the dataset, likely used for medicinal purposes. **So Statement 2 is correct.**



The World Wildlife Crime Report 2024, published by the United Nations Office on Drugs and Crime (UNODC), examines global trends, impacts, and responses to the trafficking of protected species. The Report emphasizes evidence-based analysis, and this third edition reveals insights into wildlife trafficking's scale and complexity, evaluates current intervention effectiveness, and underscores areas requiring greater focus to curb this illicit trade. **So, Statement 3 is not correct.**

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ADDITIONAL INFORMATION:

WILDLIFE CRIME IN INDIA	
About	➢ In India, wildlife crime is a pervasive problem that damages ecosystems, impacts food security, and affects the livelihoods of rural communities. In many cases, cross-border smuggling of live animals and plants can spread disease through carrier animals and plants. ➢ Major wildlife crime in India includes poaching of tigers, rhinos and the sale of Star tortoises. Tigers are an endangered species, poached for their skin and bones to cater to an illegal market. Their body parts are used in Asian medicines and tiger claws are used in jewellery. ➢ Apart from tigers, India is also witnessing a rise in wildlife crime against Rhinoceros. Driven by a soaring demand for their horn, hundreds of rhinos are being killed illegally.
Major initiatives by indian government	➢ PROJECT TIGER- One of the most successful wildlife conservation ventures, which was initiated way back in 1972, has contributed not only to the conservation of tigers but also to the entire ecosystem. This project is sponsored by the Ministry of Environment, Forest and Climate Change. About 47 tiger reserves situated in more than 17 regions, including Corbett National Park and Ranthambore National Park, are part of this project ➢ PROJECT ELEPHANT- Initiated in 1992 by the Government of India, Project Elephant aims at conserving elephants and their habitat and migratory routes by developing scientific and planned management measures.The project's endeavour is to strengthen the measures for the protection of elephants against poachers and unnatural death.

65. The Sky appears blue in colour because of,
    1. Absence of dust particles and air molecules at higher altitudes
    2. The shorter wavelengths of sunlight are scattered more than the longer wavelengths.

    Select the correct answer using the codes given below :
    (a) 1 only
    (b) **2 only**
    (c) Both 1 and 2
    (d) Neither 1 nor 2

EXPLANATION:

Rayleigh scattering is due to the electric polarizability of the particles. Light waves have oscillating electric fields that interact with the charges within a particle, allowing them to move at the same frequency. Therefore, the particle becomes a small radiating dipole whose radiation we observe as scattered light. Thus, presence of dust particles and air molecules at higher altitudes is important for the Sky appears blue in colour. **So, Statement 1 is not correct.**

During Rayleigh scattering, the shorter wavelengths of light, such as blue and violet, are scattered more by the molecules and particles compared to longer wavelengths, such as red and orange. The reason is that the shorter wavelengths are closer in size to the molecular and particle dimensions. **So, Statement 2 is correct.**

ADDITIONAL INFORMATION:

MIE SCATTERING	
About	➢ Mie Scattering Theory applies primarily to particles that are comparable in size to the wavelength of light, typically ranging from about 0.1 to 10 micrometers. ➢ The theory accounts for both the scattering and absorption of light, allowing for a more comprehensive understanding of how particles affect visible light in the atmosphere. ➢ Unlike Rayleigh scattering, which primarily results in shorter wavelengths being

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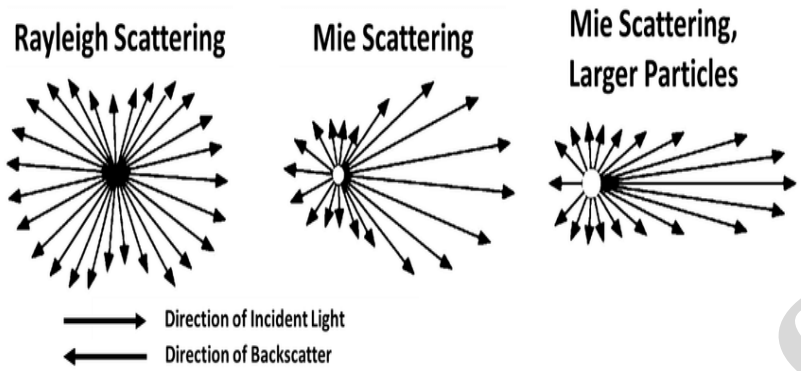
	scattered more, Mie scattering can scatter all wavelengths relatively equally, leading to white or gray appearances. ➢ Rainbows form due to a combination of refraction and Mie scattering within raindrops, while halos are often produced by ice crystals in the atmosphere using similar principles. ➢ Understanding Mie scattering is essential for meteorologists and atmospheric scientists as it helps predict visibility conditions and assess the impact of aerosols on weather phenomena. 

66. Which of the following astronomical phenomena can be classified as an 'Astronomical transients' ?
    1. Supernovae
    2. Active Galactic Nucleus
    3. Fast radio burst

    Select the correct answer using the codes given below :
    (a) 1 and 2 only
    (b) **1, 2 and 3 only**
    (c) 1 and 3 only
    (d) 3 only

EXPLANATION:

In astronomy phenomena, a 'transient' is any celestial object whose brightness changes in short spans of time. There are many kinds of astronomical transients, all of them united by phenomena that are violent in some measure. Astronomers study transients to understand where their violence comes from and what that can tell us about non-transient events. One of the most well-known such transients is supernovae when the outer layers of large stars blow up while their cores implode because the stars have run out of elements to fuse. Many a supernova has been known to become so bright that it emits light more intensely than the stars in the rest of its host galaxy combined. **So, Statement 1 is correct.**
Another famouss transient is the active galactic nucleus (AGN). When the supermassive black hole at the heart of a galaxy is actively accreting material, it is called an Active Galactic Nucleus (AGN). These are the most luminous permanent sources of energy in the cosmos. **So, Statement 2 is correct.**
In 2007, astronomers discovered a mysterious new transient called a fast radio burst (FRB). Fast radio bursts (FRBs) are millisecond flashes of radio waves from distant astronomical sources. The first FRB, later named the Lorimer Burst, was discovered in 2007, some 40 years after the discovery of radio pulsars. **So, Statement 3 is correct.**

ADDITIONAL INFORMATION:

ASTRONOMICAL PHENOMENA	
Extragalactic transients	➢ Supernovae ➢ Supernovae are the explosive end stages of the life of a star. They are very

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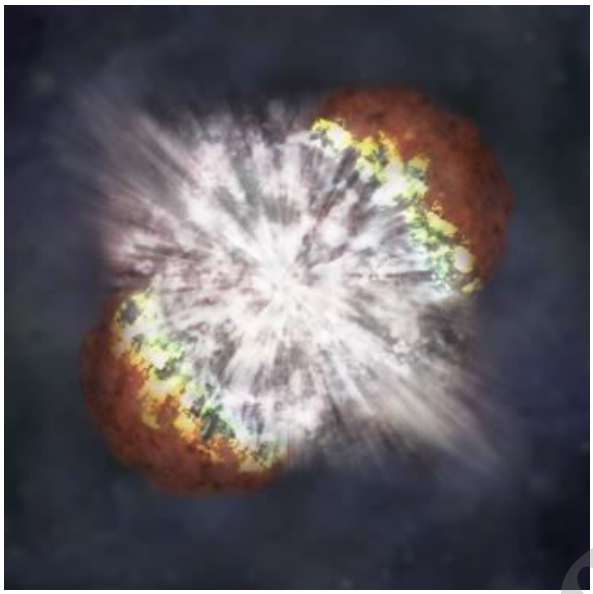
important to chemical evolution in the universe, as they create most of the heavy elements (what astronomers call metals) we see around us. After supernovae explode, these metals are incorporated into new generations of stars and may go on to form planets and life.



- Gamma-ray bursts (GRBs)

- Gamma-ray bursts are some of the most energetic events in the universe. They were first discovered in 1967 (by accident), and since that time, thousands of bursts have been detected. GRBs were first observed by the US Vela nuclear detection satellites, built to detect gamma rays from possible nuclear testing in Space. They detected a flash of gamma rays unlike any ever seen before, and continued iterations of the Vela satellites allowed for the discovery and, later the localization of more GRBs.

- Active Galactic Nuclei (AGN)
  - At the centre of every massive galaxy lives a supermassive back hole (SMBH). SMBHs are notoriously hard to study as they emit no light of their own and are only detectable through their gravitational influence on nearby stars and/or gas. Only recently has the Event Horizon Telescope (EHT) allowed us to directly observe the regions immediately surrounding a supermassive back hole.

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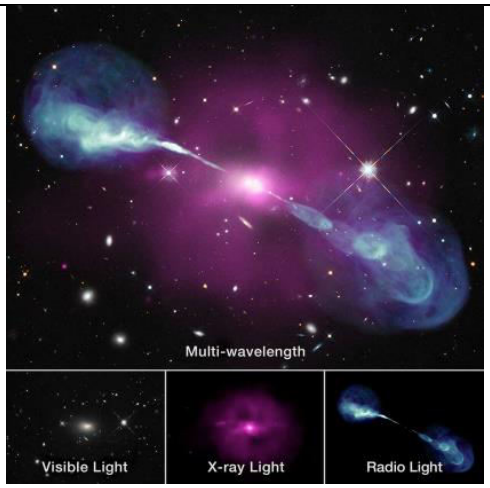
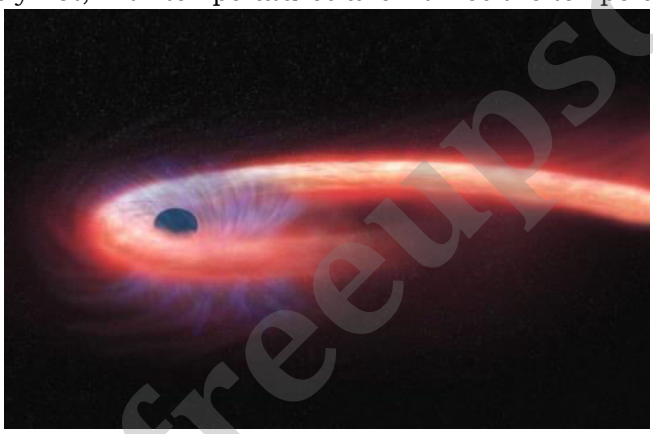


- Tidal Disruption Events (TDEs)
  - A tidal disruption event (TDE) occurs when a star passes too close to a supermassive back hole, and the tidal forces from the black hole overwhelm the gravity holding the star together.
  - When this happens, about half of the stellar mass falls back onto the supermassive black hole, causing a luminous flare. These flares are extremely hot, with temperatures a few times the temperature of our Sun.



- Fast Radio Bursts (FRBs)
  - Fast Radio Bursts are a relatively new type of transient source, which were first discovered in
- Kilonovae
  - A kilonova happens when two neutron stars (or one neutron star and a black hole) merge. When this happens, there is some matter that is flung out of the system, which then undergoes rapid nucleosynthesis and glows brightly.

67. Consider the following statements with reference to forces of nature :
    1. Gravitational force is always attractive, unlike electromagnetic force, which can be attractive or repulsive.
    2. Unlike gravitational force, electromagnetic force needs an intervening medium to travel over large distances.
    3. Protons, neutrons, and electrons experience strong nuclear force equally.

    Which of the statements given above is/are correct ?

    (a) 1 only
    (b) 2 only
    (c) 2 and 3 only
    (d) 1 and 2 only

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EXPLANATION:

Gravity is always attractive, while electromagnetic force can be attractive or repulsive. Another way of putting it is that mass comes only in one variety (there is no negative mass), but charge comes in two varieties: positive and negative charge. This is what makes all the difference. Matter is mostly electrically neutral (net charge is zero).

Thus, electric force is largely zero and gravitational force dominates terrestrial phenomena. Electric force manifests itself in an atmosphere where the atoms are ionised, and that leads to lightning. **So, Statement 1 is correct.**

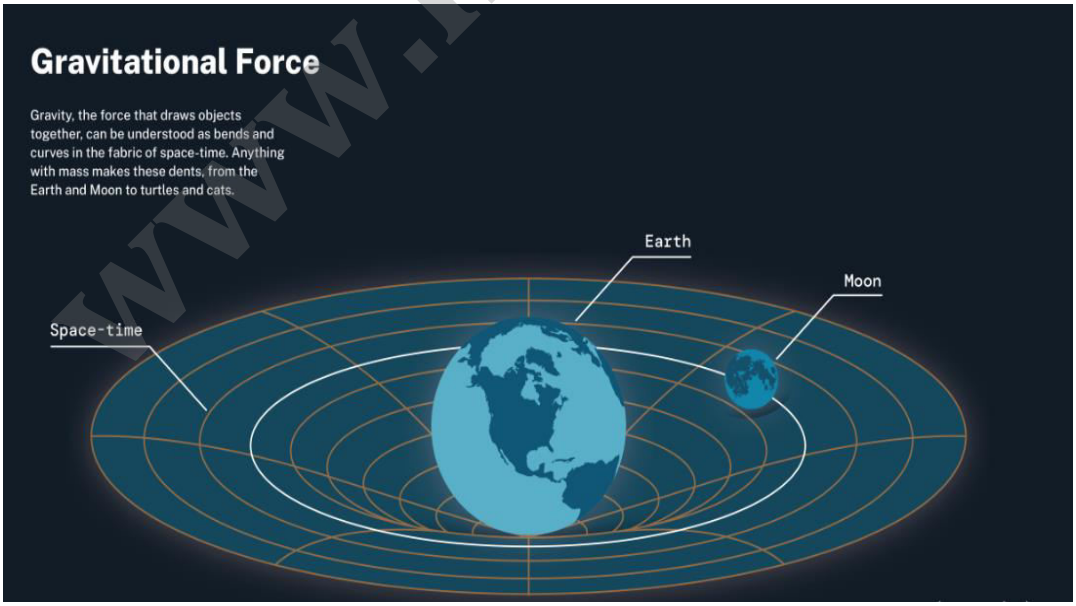
Electromagnetic force is the force between charged particles. In the simpler case, when charges are at rest, the force is given by Coulomb's law : attractive for unlike charges and repulsive for like charges. Charges in motion produce magnetic effects and a magnetic field gives rise to a force on a moving charge. Electric and magnetic effects are, in general, inseparable – hence the name electromagnetic force.

Like the gravitational force, electromagnetic force acts over large distances and does not need any intervening medium. It is enormously strong compared to gravity. **So, Statement 2 is not correct.**

The strong nuclear force binds protons and neutrons in a nucleus. It is evident that without some attractive force, a nucleus will be unstable due to the electric repulsion between its protons. This attractive force cannot be gravitational since force of gravity is negligible compared to the electric force. A new basic force must, therefore, be invoked. The strong nuclear force is the strongest of all fundamental forces, about 100 times the electromagnetic force in strength.

It is charge-independent and acts equally between a proton and a proton, a neutron and a neutron, and a proton and a neutron. Its range is, however, extremely small, of about nuclear dimensions (10–15m). It is responsible for the stability of nuclei. It must be noted that the electron does not experience this force. **So, Statement 3 is not correct.**

ADDITIONAL INFORMATION:

FUNDAMENTAL FORCES IN NATURE	
About	**Fundamental force**, in physics, is any of the four basic forces, gravitational, electromagnetic, strong, and weak, that govern how objects or particles interact and how certain particles decay. All the known forces of nature can be traced to these fundamental forces. ➢ Gravitational Force • The gravitational force is the force of mutual attraction between any two objects by virtue of their masses. It is a universal force. 

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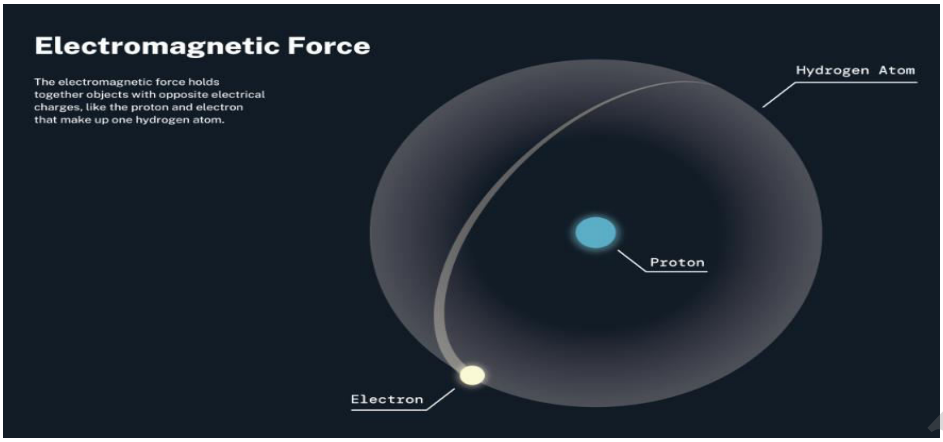
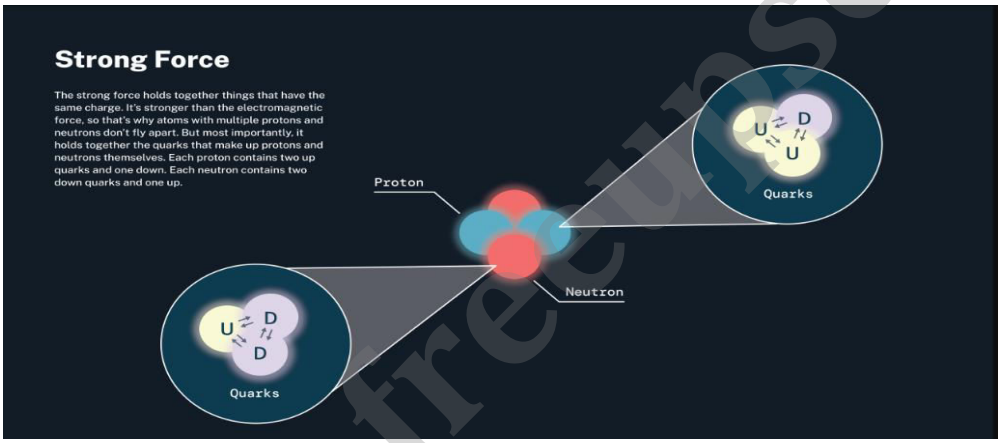
➢ Electromagnetic force

- Electromagnetic force is the force between charged particles. In the simpler case, when charges are at rest, the force is given by Coulomb's law: attractive for unlike charges and repulsive for like charges.


Electromagnetic Force
The electromagnetic force holds together objects with opposite electrical charges, like the proton and electron that make up one hydrogen atom.
Hydrogen Atom
Proton
Electron

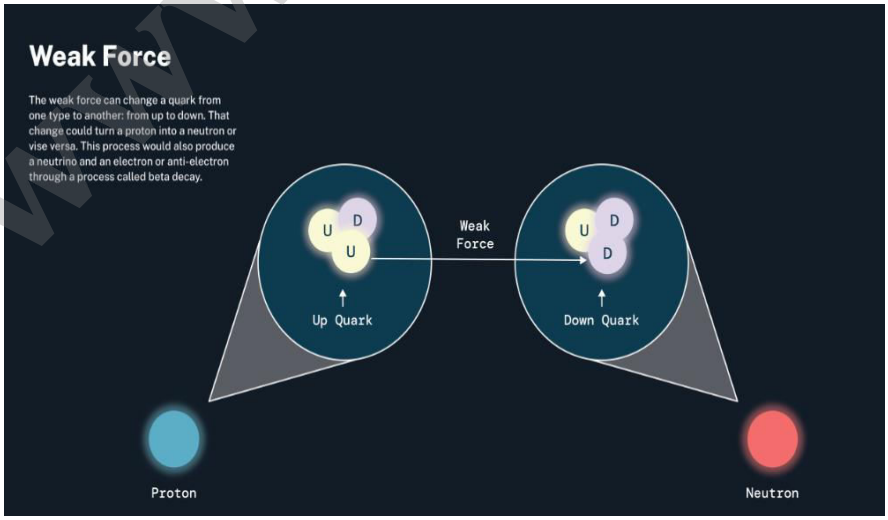
➢ Strong Force

- The strong nuclear force, or strong force for short, holds together the building blocks of atoms. It always attracts and works at two different size scales in atoms. At the level of an atomic nucleus, the strong force holds together the protons and neutrons that form the essence of the elements.


Strong Force
The strong force holds together things that have the same charge. It's stronger than the electromagnetic force, so that's why atoms with multiple protons and neutrons don't fly apart. But most importantly, it holds together the quarks that make up protons and neutrons themselves. Each proton contains two up quarks and one down. Each neutron contains two down quarks and one up.
Proton
Neutron
U
D
U
Quarks
U
D
D
Quarks

➢ Weak force

- The weak force is responsible for interactions between subatomic particles – the tiny particles that are the building blocks for matter, like protons, neutrons, and electrons.


Weak Force
The weak force can change a quark from one type to another: from up to down. That change could turn a proton into a neutron or vise versa. This process would also produce a neutrino and an electron or anti-electron through a process called beta decay.
U
D
U
Up Quark
Weak Force
U
D
D
Down Quark
Proton
Neutron

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68. With respect to Poliomyelitis disease, consider the following statements :
    1. It is a contagious disease spread mainly through the faecal-oral route.
    2. The incubation period of the disease is 7–10 days.
    3. The Virus in the disease causes paralysis within a few hours of infection.
    4. Of the 3 strains of wild Poliomyelitis, type 1 remains only in two countries.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) Only three
    (d) **All four**

EXPLANATION:

Polio is a highly infectious disease caused by a virus. Poliovirus only infects people, entering the body through the mouth. It lives in an infected person's throat and spreads through person-to-person contact. It can also contaminate food and water in unsanitary conditions. The Virus is transmitted by person-to-person spread mainly through the faecal-oral route.
So, Statement 1 is correct.

An incubation period is how long it takes for you to develop symptoms after exposure to an infectious disease. Up to 90% of those infected experience no or mild symptoms and the disease usually goes unrecognized. Symptoms usually last 2–10 days, and most recovery is complete in almost all cases. Treatments for polio focus on limiting and alleviating symptoms. The incubation period is usually 7–10 days for Poliomyelitis but can range from 4–35 days.
So, Statement 2 is correct.

A smaller proportion of people with poliovirus infection will develop more serious symptoms that affect the brain and spinal cord:

- MENINGITIS (spinal cord and/or brain infection) occurs in about 1 to 5 out of 100 people with poliovirus infection, depending on virus type.
- PARALYSIS (can't move parts of the body) or weakness in the arms, legs, or both—occurs in about 1 out of 200 people to 1 in 2000 people, depending on virus type.

However, in a certain proportion of cases, the Virus causes paralysis, usually of the legs, which is most often permanent. Paralysis can occur as rapidly as within a few hours of infection. Of those paralyzed, 5-10% die when their breathing muscles become immobilized. **So, Statement 3 is correct**.

In 1988, the World Health Assembly adopted a resolution for the worldwide eradication of polio, marking the launch of the Global Polio Eradication Initiative, spearheaded by national governments, WHO, Rotary International, the US Centers for Disease Control and Prevention (CDC), UNICEF, and later joined by the Bill & Melinda Gates Foundation and Gavi, the Vaccine Alliance.
Wild poliovirus cases have decreased by over 99% since 1988, from an estimated 350 000 cases in more than 125 endemic countries to 6 reported cases in 2021. Of the 3 strains of wild poliovirus (type 1, type 2 and type 3), wild poliovirus type 2 was eradicated in 1999 and wild poliovirus type 3 was eradicated in 2020. As of 2022, endemic wild poliovirus type 1 remains in Pakistan and Afghanistan.
So, Statement 4 is correct.

ADDITIONAL INFORMATION:

ERADICATION OF POLIO IN INDIA	
About	➢ India committed to a resolution passed by the World Health Assembly for global polio eradication in 1988. National Immunization Day (NID), commonly known as Pulse Polio Immunizationprogramme was launched in India in 1995 and is conducted twice in the early part of each year ➢ Additionally, multiple rounds (at least two) of sub-national immunization day (SNID) have been conducted over the years in high-risk states/areas.
Progress	➢ South-East Asia Region of WHO, including India, has been certified polio-free by "The Regional Certification Commission (RCC)" on 27th March 2014. ➢ India reported its last polio case from the district of Howrah, West Bengal, on 13th

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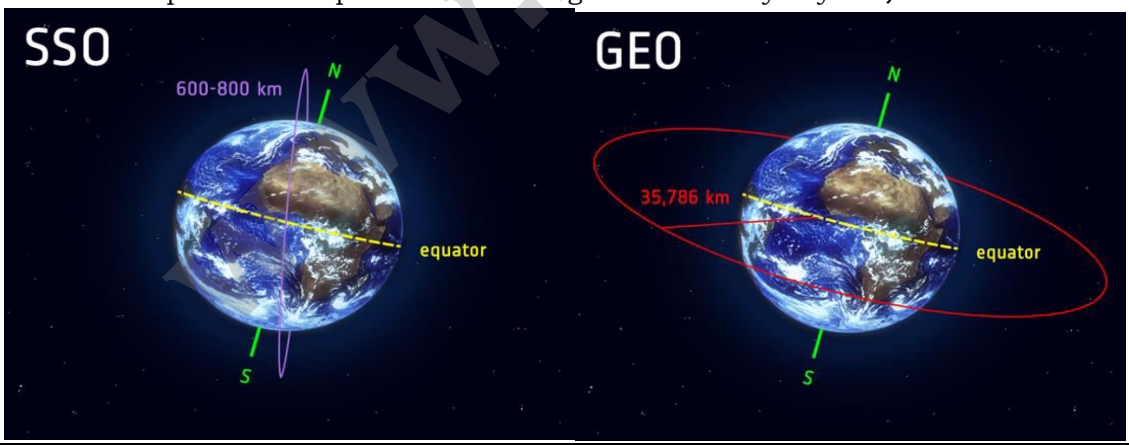
	January 2011. ➢ WHO, on 24th February 2012, removed India from the list of "endemic countries with active poliovirus transmission."
Steps by the Government	➢ Maintaining community immunity through high-quality National and Sub polio rounds each year. ➢ All States and Union Territories in the country have developed a Rapid ResponseTeam (RRT) to respond to any polio outbreak. ➢ International border vaccination is provided through continuous vaccination teams (CVT) to all eligible children round the clock. ➢ India to introduce Injectable Inactivated Poliovirus Vaccine (IPV) IPV consists of inactivated (killed) poliovirus strains of all three poliovirus types. ➢ India joins 125 other countries in introducing the Inactivated Poliovirus Vaccine (IPV) into routine immunization as part of the Polio Eradication and Endgame Strategic plan in 2015.

69. Consider the following statements :
1. Geostationary Satellites remain stationary in the sky with respect to the ground stations, while Sun-Synchronous Satellites pass over a spot on Earth at a given time every day.
2. Geostationary Satellites are widely used for telecommunications in India, whereas Sun Synchronous Satellites are preferred in remote sensing and imaging satellites.

Which of the statements given above is/are ***not*** correct ?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

EXPLANATION:

Geo stationary orbit is used by satellites that need to stay constantly above one particular place over Earth, such as telecommunication satellites. This way, an antenna on Earth can be fixed to always stay pointed towards that satellite without moving. It can also be used by weather monitoring satellites because they can continually observe specific areas to see how weather trends emerge there.
Sun-synchronous orbit (SSO) is a particular kind of polar orbit. Satellites in SSO, travelling over the polar orbits, are synchronous with the Sun. This means they are synchronised to always be in the same 'fixed' position relative to the Sun, so the satellite always visits the same spot at the same local time. For example, passing the city of Paris every day at noon exactly.
Hence, Geostationary Satellites remain stationary in the sky with respect to the ground station, and sun-synchronous satellites pass over a spot on Earth at a given time every day. **So, statement 1 is correct.**



The geostationary satellites are used for telecommunication in India. Communications satellites are often given geostationary orbits or close to geostationary so that the satellite antennas that communicate with them do not have to move but can be pointed permanently at the fixed location in the sky where the satellite appears.

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Sun-synchronous orbits are particularly useful for missions that acquire images of the Earth because shadows from objects at a given location on the Earth's surface are always cast from the same angle. This simplifies the comparison of images taken on different days to detect changes. Satellites in this orbit are often placed at low altitudes (700 to 800 km) so that they provide complete coverage of the Earth's surface at least once per day. Remote sensing and meteorological satellites are placed in the sun-synchronous orbit. Orbview, Quickbird, IKONOS, SPOT, Landsat, ERS, RADARSAT, etc., are examples of satellites orbiting in sun-synchronous orbit. **So, Statement 2 is correct.**

ADDITIONAL INFORMATION:

GEOSYNCHRONOUS ORBITAL SATELLITES	
About	➢ A geosynchronous orbit is an orbit which has an orbital period that matches the Earth's sidereal rotation period. ➢ It is a west-to-east equatorial orbit in which a satellite is placed on the equatorial (0° latitude) orbital plane at an altitude of about 36000 km above the Earth's surface. ➢ There is a special case of a geosynchronous orbit which is known as geostationary orbit. This is a geosynchronous orbit that is circular and at zero inclination, i.e. directly above the equator. As a result, the satellites remain stationary vertically above a fixed point on the Earth's surface. Hence, relative to any location on Earth, the position of the satellites remains stationary. This orbit is called a geostationary orbit, and the satellite revolving in this orbit is called a geostationary satellite. ➢ The geostationary satellite takes ~24 hours (i.e. one day) to complete one orbit around the Earth, the same time as Earth's rotation. ➢ Geostationary satellites provide a large coverage useful for monitoring deadly local storms and tropical cyclones. Since these satellites continuously view the same scene, as a consequence, they are ideal for studying dynamic phenomena, such as cyclone movement, cloud motion, etc.

70. Consider the following statements with respect to Black Holes :
    1. They are huge concentrations of matter packed into very tiny spaces.
    2. The rings of gas surrounding the Black Hole emit X-rays.
    3. As moving away from the center of the black hole, the thickness of the rings reduces.

    How many of the statements given above are correct ?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

EXPLANATION:

Black holes are among the most mysterious cosmic objects, much studied but not fully understood. These objects aren't really holes. They're huge concentrations of matter packed into very tiny spaces. A black hole is so dense that gravity just beneath its surface, the event horizon, is strong enough that nothing, not even light, can escape. The event horizon isn't a surface like Earth's or the Sun's. It's a boundary that contains all the matter that makes up the black hole. **So, Statement 1 is correct**.

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Black holes don't emit or reflect light, making them effectively invisible to telescopes. Scientists primarily detect and study them based on how they affect their surroundings. Black holes can be surrounded by rings of gas and dust, called accretion disks, that emit light across many wavelengths, including X-rays. For more than 40 years, however, observations show that black holes also produce considerable amounts of "hard" X-rays, light with energy tens to hundreds of times greater than soft X-rays. **So, Statement 2 is correct**.

From every viewing angle, thin rings of light appear at the edge of the black hole shadow. These rings are really multiple, highly distorted images of the accretion disk. Here, light from the disk actually orbits the black hole multiple times before escaping to us. Rings closer to the black hole become thinner and fainter. **So, Statement 3 is not correct**.

ADDITIONAL INFORMATION:

BLACK HOLES	
About	➢ A black hole is an extremely dense object in space from which no light can escape. While black holes are mysterious and exotic, they are also a key consequence of how gravity works: When a lot of mass gets compressed into a small enough space, the resulting object rips the very fabric of space and time, becoming what is called a singularity. ➢ The nearest known black hole, Gaia BH1, is about 1,500 light-years away. ➢ The most distant black hole detected at the centre of a galaxy called QSO J0313-1806 is around 13 billion light-years away. ➢ If you replaced the Sun with a black hole of the same mass, the solar system would get a lot colder, but the planets would stay in their orbits. ➢ Massive objects like black holes can bend and distort light from more distant objects. This effect, called gravitational lensing, can be used to find isolated black holes that are otherwise invisible.
Types	Astronomers generally divide black holes into three categories according to their mass: stellar mass, supermassive, and intermediate-mass. Cosmologists suspect a fourth type, primordial black holes formed during the birth of the universe, may also lurk undetected in the cosmos. ➢ Stellar • When a star with more than eight times the Sun's mass runs out of fuel, its core collapses, rebounds, and explodes as a supernova. What's left behind depends on the star's mass before the explosion. • If it is near the threshold, it creates a city-sized, superdense neutron star. If it had around 20 times the Sun's mass or more, the star's core collapses into a stellar-mass black hole. ➢ Supermassive • Every large galaxy, including our Milky Way, has a supermassive black hole at its centre. • These monster objects have hundreds of thousands to billions of times the Sun's mass, although some scientists place the lower boundary at tens of thousands. ➢ Intermediate • Scientists believe there should be a continuum of sizes because, over cosmic time, collisions between stellar-mass black holes should have created some intermediate-mass black holes. • These should range from around one hundred to hundreds of thousands of times the Sun's mass – or tens of thousands, depending on how supermassive black holes are defined. ➢ Primordial • The primordial black holes formed in the first second after the birth of the universe.

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	At that moment, pockets of hot material may have been dense enough to form black holes, potentially with masses ranging from 100,000 times less than a paperclip to 100,000 times more than the Sun's. • Then, as the universe quickly expanded and cooled, the conditions for forming black holes this way ended.

71. Consider the following :

Sl. No.	***Moon***	***Belong to Planet***	***Description***
1.	Titan	Saturn	Only moon with a dense atmosphere like the earth
2.	Callisto	Jupiter	Second Largest moon in the solar system
3.	Europa	Saturn	Has atmosphere primarily composed of oxygen
4.	Triton	Neptune	Moon with Seasonal change and weather pattern

In which of the above rows is the given information correctly matched ?

(a) 1 and 2
(b) 2 and 3
(c) 3 and 4
(d) 1 and 4

EXPLANATION:

Saturn has 146 moons in its orbit, more than any other planet. Titan is Saturn's largest moon. It is an icy world whose surface is completely obscured by a golden, hazy atmosphere. Titan is the second-largest moon in our solar system.

This mammoth moon is the only moon in the solar system with a dense atmosphere, and it's the only world besides Earth with standing bodies of liquid, including rivers, lakes and seas, on its surface. Like Earth, Titan's atmosphere is primarily nitrogen plus a small amount of methane.

It is the sole other place in the solar system known to have an earthlike cycle of liquids raining from clouds, flowing across its surface, filling lakes and seas, and evaporating back into the sky (akin to Earth's water cycle). Titan is also thought to have a subsurface ocean of water. **So, Row (1) is correct.**

Jupiter has 95 moons, which the International Astronomical Union has officially recognised. Jupiter's four largest moons were the first moons discovered beyond Earth.

- They are called the Galilean satellites after Italian astronomer Galileo Galilei, who is credited with discovering them in 1610.
- Callisto is Jupiter's second-largest and third-largest moon in our solar system. Its surface is the most heavily cratered of any object in our solar system. Images of Callisto captured by passing spacecraft show bright white spots standing out against darker regions. Scientists think the bright areas are mostly ice, and the darker patches are where ice has eroded. **So, Row (2) is not correct**.

Europa is the fourth largest of Jupiter's 95 moons. It's the sixth-closest moon on the planet. It has a very thin atmosphere composed primarily of oxygen. Europa may be one of the most promising places in our solar system to find present-day environments suitable for some form of life beyond Earth. Scientists believe a saltwater ocean lies beneath its icy shell, holding twice as much water as Earth's global ocean. It also may contain chemical elements that are key ingredients to life. NASA launched its Europa Clipper spacecraft in October 2024 to determine whether there are places below Europa's surface that could support life. **So, Row (3) is not correct**.

Neptune has 16 known moons. English merchant and astronomer William Lassell discovered the first and largest moon, Triton, on Oct. 10, 1846, just 17 days after a Berlin observatory discovered Neptune.

Triton is the only large moon in the solar system that circles its planet in a direction opposite to the planet's rotation (a retrograde orbit), which suggests that it may once have been an independent object that Neptune captured. Triton is extremely cold, with surface temperatures around minus 391 degrees Fahrenheit (minus 235 degrees Celsius). And yet, despite this deep freeze at Triton, Voyager 2 discovered geysers spewing icy material upward more than 5 miles (8 kilometres). Triton's thin atmosphere, also

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discovered by Voyager, has been detected from Earth several times since and is growing warmer, but scientists do not yet know why.
During winter, Triton's atmosphere condenses and falls to the surface as nitrogen, methane, and carbon monoxide snow. During the summer, when more direct sunlight hits the Triton surface, a thin surface layer evaporates to form the atmosphere again. Hence, seasonal changes and weather patterns are observed. **So, Row (4) is correct**.

ADDITIONAL INFORMATION:

MOONS OF OUR SOLAR SYSTEM	
Mars	Mars has two moons, Phobos and Deimos. Both are thought to be captured asteroids or debris from early in the formation of our solar system. ➢ Phobos • Phobos is the largest of Mars's two moons. • It orbits Mars three times a day and is so close to the planet's surface that in some locations on Mars, it cannot always be seen. ➢ Deimos • Deimos is the smaller of Mars's two moons. It's 9 by 7 by 6.8 miles (15 by 12 by 11 kilometers). • Deimos orbits Mars every 30 hours. Deimos is a small and lumpy, heavily cratered object. Its craters are generally smaller than 1.6 miles (2.5 kilometres) in diameter, and it lacks the grooves and ridges seen on Phobos. • Deimos is a dark body that appears composed of C-type surface materials, similar to that of asteroids found in the outer asteroid belt.
Uranus	Uranus has 28 known moons, including five major moons: Miranda, Ariel, Umbriel, Titania, and Oberon. ➢ Miranda • Miranda looks like it was pieced together from parts that didn't merge properly. At about 500 km in diameter, it's only one-seventh as large as Earth's moon, a size that seems unlikely to support much tectonic activity. • Miranda sports one of the strangest and most varied landscapes among extraterrestrial bodies, including three large features known as "coronae," unique among known objects in our solar system. ➢ Titania • Titania is Uranus' largest moon. Images taken by Voyager 2 almost 200 years after Titania's discovery revealed signs that the moon was geologically active.
Pluto	Pluto has five moons. Its largest moon, Charon, is about half the size of Pluto, making it the largest known moon relative to its parent planet in our solar system. ➢ Charon • Charon is the largest of Pluto's five moons. At half the size of Pluto, Charon is the largest known satellite relative to its parent body. • The same surfaces of Charon and Pluto always face each other, a phenomenon called mutual tidal locking. Charon orbits Pluto every 6.4 Earth days. ➢ Nix • Nix was named after the Greek goddess of darkness and night and the mother of Charon. • Nix was discovered in June 2005 by Hal Weaver and a large team of astronomers using the Hubble Space Telescope.

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72. Consider the following statements regarding the Red List of Mangrove Ecosystems :
    1. It is the first-ever global assessment by the International Union for Conservation of Nature.
    2. Nearly one-third of the global mangrove ecosystem is affected due to global sea-level rise.
    3. The Eastern parts of India are categorised as vulnerable in the Red list of Mangrove Ecosystems.

    Which of the above statements is/are correct ?

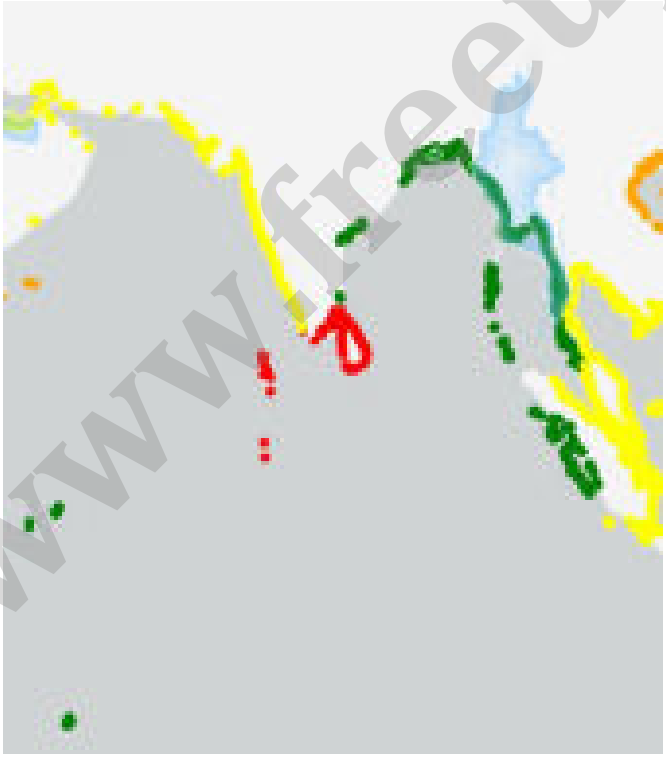
    (a) 1 only
    (b) 2 only
    (c) **1 and 2 only**
    (d) 1 and 3 only

EXPLANATION:

Red List Of Mangrove Ecosystems is the first global assessment of a full ecosystem functional group across the planet using the Red List of Ecosystems. It raises concerns about the risk of collapse of mangrove ecosystems. It is the first time mangroves along the road have been assessed using the IUCN Red List of Ecosystems as a measurement tool. **So, Statement 1 is correct.**

It showed that nearly 20 per cent (19.6 per cent) of the assessed mangroves are at high risk and have been marked as endangered or critically endangered, indicating a severe risk of collapse. Nearly 33 per cent of the planet's mangrove systems are threatened by climate change 25% of the global mangrove area is predicted to be submerged in the next 50 Years. Sea-level rise will severely affect one-third of the world's mangrove ecosystem provinces. **So, Statement 2 is correct.**

Fifty per cent of Mangrove Ecosystems units are at risk of collapse (in the IUCN threat categories of Vulnerable (VU), Endangered (EN), or Critically Endangered (CR) equally, they represent 50% of the world's mangrove area. And one out of five are at severe risk of collapse (either Endangered or Critically Endangered). The other units are Near Threatened (NT), Least Concern (LC) or Not Evaluated (NE). The western parts of India are categorized as vulnerable in the Red list of Mangrove Ecosystems. **So, Statement 3 is NOT correct.**



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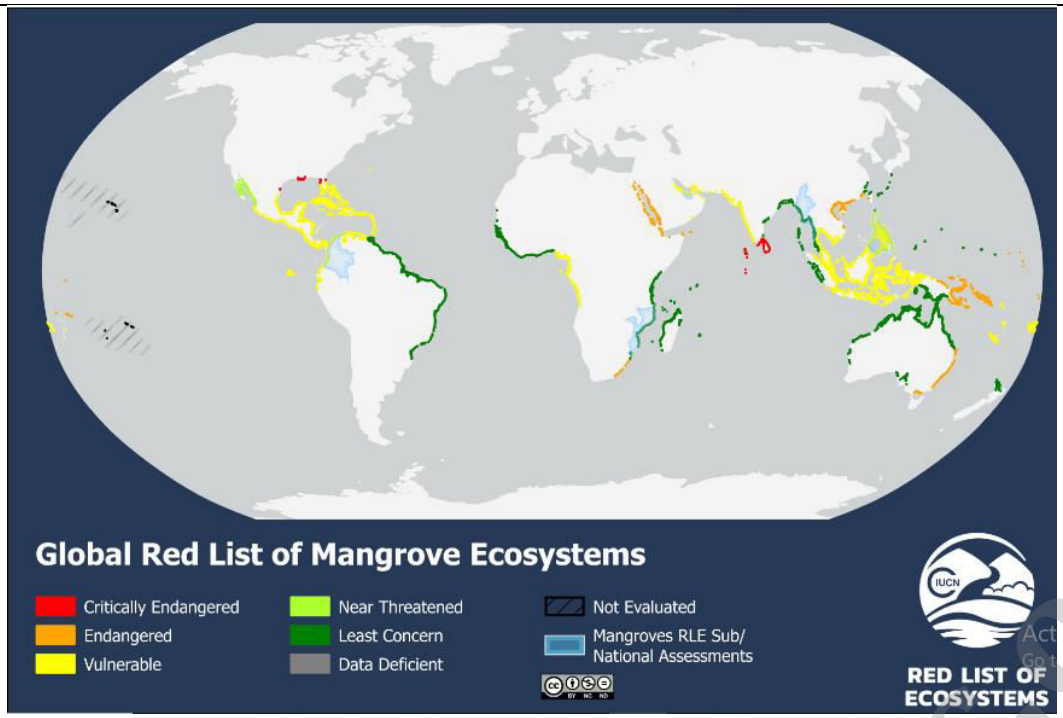

ADDITIONAL INFORMATION:

MEASURES TAKEN BY INDIAN GOVERNMENT	
ABOUT	➢ The Government has taken steps to protect sustain, conserve and augment forests in the country through promotional as well as regulatory measures. The promotional measures are being implemented through a Central Sector Scheme under the National Coastal Mission Programme on 'Conservation and Management of Mangroves and Coral Reefs'.Annual Management Action Plans (MAP) for the conservation and management of mangroves are formulated and implemented in all the coastal States and Union Territories. ➢ Regulatory measures are implemented through the Coastal Regulation Zone (CRZ)(2019) under the • Environment (Protection) Act, 1986 • Wild Life (Protection) Act, 1972 • Indian Forest Act, 1927 • Biological Diversity Act, 2002 ➢ The Government, under Centrally sponsored scheme for conservation & Management of Mangroves, extend assistance to Coastal State/UTs for implementation of action plans including survey and demarcation, alternation and supplementary livelihood, protection measures and education and awareness activities. ➢ The Ministry piloted an Integrated Coastal Zone management Project in Coastal stretches of 3 states namely GUJARAT, ODISHA AND WEST BENGAL, with objective of Conservation and Protection of Coastal resources which included plantation of mangroves as one of the major activities.

73. Which of the following devices is used for detecting an optical signal ?
(a) Photodiodes
(b) Light emitting diodes
(c) Photovoltaic device
(d) Invertor

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EXPLANATION:

The functioning of the following optoelectronic devices:

(i) Photodiodes used for detecting optical signal (photodetectors).
(ii) Light emitting diodes (LED) which convert electrical energy into light.
(iii) Photovoltaic devices which convert optical radiation into electricity (solar cells)

A Photodiode is again a special purpose p-n junction diode fabricated with a transparent window to allow light to fall on the diode. It is operated under reverse bias. When the photodiode is illuminated with light (photons) with energy (hν) greater than the energy gap (Eg) of the semiconductor, then electron-hole pairs are generated due to the absorption of photons. The diode is fabricated such that the generation of e-h pairs takes place in or near the depletion region of the diode. Due to electric field of the junction, electrons and holes are separated before they recombine. The direction of the electric field is such that electrons reach n-side and holes reach p-side. Electrons are collected on n-side and holes are collected on p-side giving rise to an emf. When an external load is connected, current flows. The magnitude of the photocurrent depends on the intensity of incident light (photocurrent is proportional to incident light intensity). It is easier to observe the change in the current with change in the light intensity, if a reverse bias is applied. Thus photodiode can be used as a photodetector to detect optical signals. **So,option (a) is correct.**

Light emitting diode is a heavily doped p-n junction which under forward bias emits spontaneous radiation. The diode is encapsulated with a transparent cover so that emitted light can come out. When the diode is forward biased, electrons are sent from n → p (where they are minority carriers) and holes are sent from p → n (where they are minority carriers). At the junction boundary the concentration of minority carriers increases compared to the equilibrium concentration (i.e., when there is no bias). Thus at the junction boundary on either side of the junction, excess minority carriers are there which recombine with majority carriers near the junction. On recombination, the energy is released in the form of photons. Photons with energy equal to or slightly less than the band gap are emitted. When the forward current of the diode is small, the intensity of light emitted is small. As the forward current increases, intensity of light increases and reaches a maximum. Further increase in the forward current results in decrease of light intensity. LEDs are biased such that the light emitting efficiency is maximum. The V-I characteristics of a LED is similar to that of a Si junction diode. But the threshold voltages are much higher and slightly different for each colour. The reverse breakdown voltages of LEDs are very low, typically around 5V. So care should be taken that high reverse voltages do not appear across them. LEDs that can emit red, yellow, orange, green and blue light are commercially available. The semiconductor used for fabrication of visible LEDs must at least have a band gap of 1.8 eV (spectral range of visible light is from about 0.4 μm to 0.7 μm, i.e., from about 3 eV to 1.8 eV). The compound semiconductor Gallium Arsenide – Phosphide (GaAs1–x Px) is used for making LEDs of different colours. GaAs0.6 P0.4 (Eg ~ 1.9 eV) is used for red LED. GaAs (Eg ~ 1.4 eV) is used for making infrared LED. These LEDs find extensive use in remote controls, burglar alarm systems, optical communication, etc.**So, option (b) is not correct.**

A photovoltaic (PV) cell, commonly called a solar cell, is a nonmechanical device that converts sunlight directly into electricity. Some PV cells can convert artificial light into electricity. A PV cell is made of semiconductor material. When photons strike a PV cell, they will reflect off the cell, pass through the cell, or be absorbed by the semiconductor material. Only the photons that are absorbed provide energy to generate electricity. When the semiconductor material absorbs enough sunlight (solar energy), electrons are dislodged from the material's atoms. Special treatment of the PV cell's surface during manufacturing makes the front surface of the cell more receptive to the dislodged, or *free*, electrons so that the electrons naturally migrate to the surface of the cell. **So, option (c) is not correct.**

Inverters are also called AC Drives, or VFD (variable frequency drive). It is also responsible for controlling speed and torque for electric motors The inverter is a device that converts DC electricity (battery, storage battery) into AC power with a fixed frequency and voltage or with frequency modulation and voltage management (usually 220V, 50Hz sine wave). It is made up of semiconductor power devices as well as drive and control circuits for inverters, The creation of new high-power semiconductor devices and drive control circuits has been aided by the advancement of microelectronic and power electronics technologies. Insulating gates are now often used in inverters, Polar transistors, power field-effect

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transistors, MOS controller thyristors, and intelligent power modules are examples of advanced and easy-to-control high-power technologies. **So, option (d) is not correct.**

74. Which of the following is the reason for an object to float when placed on the surface of water ?
    (a) The gravitational pull acting on the object is greater than the up thrust of water on the object.
    (b) The density of the object is greater than the density of the water
    (c) **The density of the object is less than the density of the water**
    (d) The up thrust of water on the object is less than the weight of the object.

EXPLANATION:

The upward force exerted by the water on the bottle is known as upthrust or buoyant force. In fact, all objects experience a force of buoyancy when they are immersed in a fluid. The magnitude of this buoyant force depends on the density of the fluid.
The nail sinks. The force due to the gravitational attraction of the earth on the iron nail pulls it downwards. There is an upthrust of water on the nail, which pushes it upwards. But the downward force acting on the nail is greater than the upthrust of water on the nail. So it sinks. The Cork floats while the nail sinks. This happens because of the difference in their densities. The density of a substance is defined as the mass per unit volume. The density of cork is less than the density of water. This means that the upthrust of water on the cork is greater than the weight of the cork. So it floats
The density of an iron nail is more than the density of water. This means that the upthrust of water on the iron nail is less than the weight of the nail. So it sinks. Therefore objects of density less than that of a liquid float on the liquid. The objects of density greater than that of a liquid sink in the liquid. **So, Option (c) is correct.**

75. With reference to the Anti-Submarine Warfare Shallow Water Craft (ASW SWC) project, consider the following statements :
    1. The Mahe class of ASW SWC ships, named after ports of strategic importance along the Indian coast, will undertake anti-submarine operations and mine-laying operations.
    2. The ASW SWC ships with over 80% Indigenous content, which boosts India's progress towards 'Aatmanirbhar Bharat'.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

EXPLANATION:

The fourth and fifth ships of the Anti-Submarine Warfare Shallow Water Craft (ASW SWC) project, named 'Malpe' and 'Mulki', are being built by M/s Cochin Shipyard Ltd for the Indian Navy. The Mahe class ASW Shallow Water Craft have been named after ports of strategic importance along the Indian coast.
The Mahe class of ships will be equipped with indigenously developed, state-of-the-art underwater sensors, and are envisaged to undertake anti-submarine operations in coastal waters as well as Low Intensity Maritime Operations and Mine Laying Operations. The ASW SWC ships can achieve a maximum speed of 25 knots with an endurance of up to 1800 nautical miles. **So, Statement 1 is correct.**

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The ASW SWC ships will have over 80% indigenous content, which aligns with India's 'Aatmanirbhar Bharat' initiative. This will ensure that large-scale defence production is executed by Indian manufacturing units, generating employment and capability enhancement within the country. **So, Statement 2 is correct.**

ADDITIONAL INFORMATION:

THE ANTI-SUBMARINE WARFARE SHALLOW WATERCRAFT (ASW SWC) PROJECT	
About	The introduction of the ASW-SWC class is a major move in enhancing the Indian Navy's operational readiness and ability to secure maritime interests in a constantly evolving geopolitical landscape.
Types	➢ Mahe, Malvan and Mangrol, the first three ships of eight Anti-Submarine Warfare (ASW) Shallow Water Craft (CSL) projects being built by Cochin Shipyards Ltd. ➢ The INS Androth is the second in a series of eight Anti-Submarine Warfare Shallow watercraft (ASW SWC) being built by GRSE for the Indian Navy. ➢ 'Anjadip', the third of eight ships of the ASW Shallow Water Craft (SWC) Project being built by M/s GRSE for the Indian Navy, ➢ Malpe and Mulki, fourth and fifth ships of the Eight Anti-Submarine Warfare Shallow Water Craft project, being built by M/s Cochin Shipyard Ltd.
Capabilities and Specifications	The newly launched ships, Malpe and Mulki, are designed to enhance India's coastal defence and anti-submarine warfare capabilities. ➢ The ships measure 78 meters in length and displace around 900 tons. They can achieve up to 25 knots and have an endurance of 1,800 nautical miles, enabling them to cover vast coastal waters efficiently. ➢ The Ministry of Defence has confirmed that these vessels are part of a larger effort to improve the Indian Navy's coastal defence strategy. The Navy stated, "The addition of these ships will significantly improve India's capability in coastal shallow water anti-submarine warfare."

76. The Periodic Labour Force Survey was conducted by which of the following ministry ?
(a) Ministry of Labour and Employment
(b) Ministry of Finance
(c) Ministry of Statistics and program implementation
(d) Ministry of Home Affairs

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EXPLANATION:

The National Sample Survey Office (NSSO) launched the Periodic Labour Force Survey (PLFS) in April 2017.

The objective of PLFS is primarily twofold:

- To estimate the key employment and unemployment indicators (viz., worker population ratio, labour force participation rate, and unemployment rate) in a short time interval of three months for the urban areas only in the 'current weekly status' (cws). Current Weekly Status (CWS) is the activity status of the person determined on the basis of a reference period of the last 7 days preceding the date of the survey.
- To estimate employment and unemployment indicators in both 'usual status' (ps+ss) and CWS in both rural and urban areas annually. The usual status (ps+ss) is a usual principal and subsidiary status approach which takes into consideration both the major time criterion and shorter time period (30 days or more in any economic activity). A person who has worked even for 30 days or more in any economic activity during the reference period of the last twelve months is considered as employment under this approach.

The National Sample Survey Office (NSSO) of the Ministry of Statistics and Programme Implementation releases the Periodic Labour Force Survey (PLFS). **So, Option (c) is correct.**

77. Consider the following statements with regard to the components of food :
    1. Roughage or dietary fibre does not provide any nutrients to our body.
    2. Fats give much more energy as compared to the same amount of carbohydrates.
    3. Repeated washing of rice and pulses are important and its does not remove any of the vitamins and minerals present in them.
    4. All deficiency diseases can be prevented by taking a balanced diet.

    How many of the statements given above are correct ?

    (a) Only one
    (b) Only two
    (c) Only three
    (d) All four

EXPLANATION:

Dietary fibres, also known as roughage, refer to the carbs in plants that your body cannot digest. Roughage is mainly provided by plant products in our foods. Whole grains and pulses, potatoes, fresh fruits and vegetables are the main sources of roughage. Roughage does not provide any nutrients to our body but is an essential component of our food and adds to its bulk. This helps our body get rid of undigested food. **So, Statement 1 is correct.**

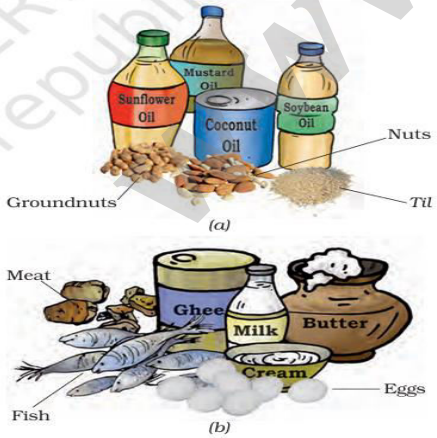

Fig. 1.4 Some sources of fats: (a) plant sources and (b) animal sources

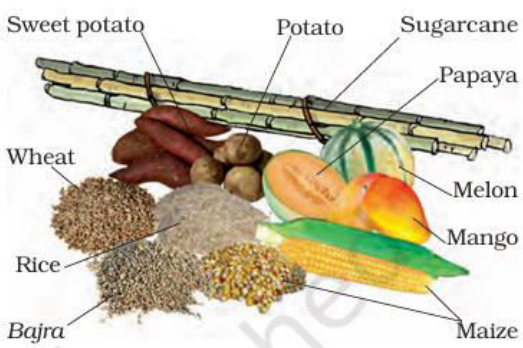

Fig. 1.3 Some sources of carbohydrates

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Carbohydrates mainly provide energy to our body. 1 gm of carbohydrate gives 4kcal of energy. Fats also give us energy. In fact, fats give much more energy as compared to the same amount of carbohydrates. 1 gm of fat gives 9 kcal of energy. Foods contains fats in small quantities. **So, Statement 2 is correct.**
If vegetables and fruits are washed after cutting or peeling them, they may lose some vitamins. The skins of many vegetables and fruits contain vitamins and minerals. Similarly, repeated washing of rice and pulses may remove some vitamins and minerals present in them. We all know that cooking improves the taste of food and makes it easier to digest. However, cooking also results in the loss of certain nutrients. Excess water used during cooking and thrown away can cause the loss of many useful proteins and considerable amounts of minerals. **So, Statement 3 is not correct.**
A balanced diet provides all the nutrients in the required amounts and proper proportions. A deficiency of one or more nutrients can cause diseases or disorders in our body. Diseases that occur due to a lack of nutrients over a long period are called deficiency diseases. Deficiency of different vitamins and minerals may also result in certain diseases or disorders. Hence, all deficiency diseases can be prevented by taking a balanced diet. **So, Statement 4 is correct.**

ADDITIONAL INFORMATION:

THE COMPONENTS OF FOOD	
About	Food is anything that we eat that nurtures our bodies. It is essential because it contains substances which perform important functions in our body.
Key terms	➢ Nutrition is the process by which food is taken in and utilised by the body. ➢ Nutrients are the chemical substances present in food and are responsible for nourishing the body. • Carbohydrates, proteins, fats and oils are macronutrients • 1 gm of carbohydrate gives 4kcal of energy. Kilocalorie is the measure of energy in food. • 1 gm of protein gives 4kcal of energy • 1 gm of fat gives 9 kcal of energy. • Minerals and vitamins are called micronutrients. • Calcium is necessary for bone formation, blood clotting and muscular contraction. • Iron is essential for haemoglobin formation. • Iodine is necessary for growth and development.
Vitamins	Our body contains very little quantity of vitamins, however, you will be surprised to know that they are responsible for all the major functions of the body. These vitamins are of two types: ➢ Fat-soluble: A, D, E and K ➢ Water soluble: B and C
Some diseases/disorders caused by	**Table 1.3 – Some diseases/disorders caused by deficiency of vitamins and minerals**

Vitamin/ Mineral	Deficiency disease/disorder	Symptoms
Vitamin A	Loss of vision	Poor vision, loss of vision in darkness (night), sometimes complete loss of vision
Vitamin B1	Beriberi	Weak muscles and very little energy to work
Vitamin C	Scurvy	Bleeding gums, wounds take longer time to heal
Vitamin D	Rickets	Bones become soft and bent
Calcium	Bone and tooth decay	Weak bones, tooth decay
Iodine	Goiter	Glands in the neck appear swollen, mental disability in children
Iron	Anaemia	Weakness

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78. With respect to the VIPER mission, consider the following statements:
    1. It is the first robotic Moon rover by ISRO.
    2. It is designed to search for volatile molecules, such as water and carbon dioxide, at lunar temperatures.
    3. During exploration, the rover will endure extreme temperature conditions, dynamic lighting, and complex terrain.

    Which of the statements given above are correct ?

    (a) 1 and 2 only
    (b) 2 and 3 only
    (c) 1 and 3 only
    (d) 1, 2 and 3

EXPLANATION:

VIPER, which stands for Volatiles Investigating Polar Exploration Rover, is a lunar rover mission by NASA which is designed to explore the relatively nearby but extreme environment of the Moon in search of ice and other potential resources. This mobile robot was slated to land at the South Pole of the Moon on a 100-day mission. It is not an ISRO mission. **So, Statement 1 is not correct.**

VIPER is a mobile robot that will scout for ice on the surface of the Moon to create resource maps intended to help inform future missions. This robotic mission is designed to search for volatiles, which are molecules that easily vaporise, like water and carbon dioxide, at lunar temperatures. These materials could provide resources for future human exploration on the Moon. **So, Statement 2 is correct.**

VIPER's exploration of the Moon means that the rover will endure extreme temperature conditions, dynamic lighting, and complex terrain, while near-real-time rover driving will present new engineering and design challenges that the team must overcome. VIPER will explore inside dark craters where the Sun never reaches, making it the first NASA rover to need headlights. **So, Statement 3 is correct.**

79. Consider the following statements:
    1. Conventionally, in an electric circuit, the direction of electric current is taken as the direction of the flow of electrons.
    2. The fuse material with high resistivity is connected in series with the electrical circuits as a safety device.

    Which of the statements given above is/are correct ?

    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

EXPLANATION:

An electric current's continuous and closed path is called an electric circuit. Electric current is expressed by the amount of charge flowing through a particular area in unit time. In other words, it is the rate of flow of electric charges. In circuits using metallic wires, electrons constitute the flow of charges.

However, electrons were not known at the time when the phenomenon of electricity was first observed. So, electric current was considered to be the flow of positive charges and the direction of flow of positive charges was taken to be the direction of electric current. Conventionally, in an electric circuit, the direction of electric current is taken as opposite to the direction of the flow of electrons, which are negative charges. **So, Statement 1 is not correct.**

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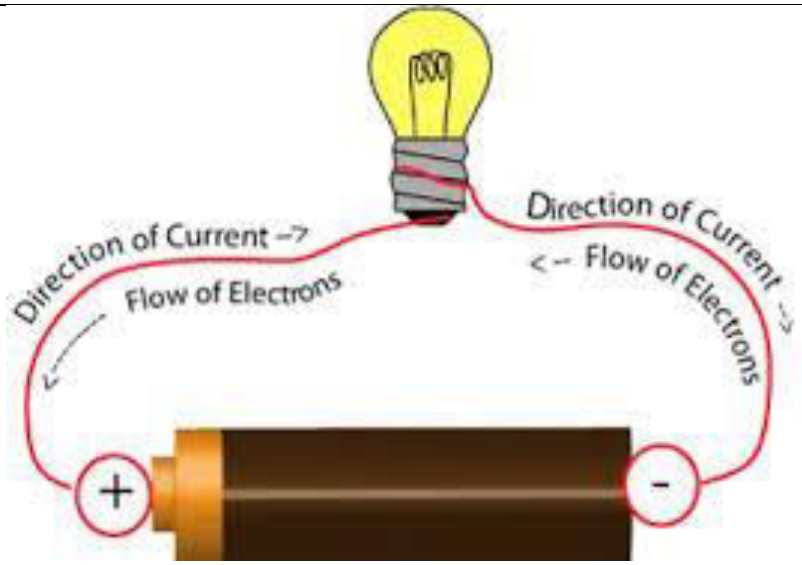

Fuse materials are chosen for their high resistivity and low melting point to protect electrical circuits by breaking the circuit when excessive current flows through them. The fuse is placed in series with the device. It consists of a piece of wire made of a metal or an alloy of appropriate melting point, for example, aluminium, copper, iron, lead, etc. If a current larger than the specified value flows through the circuit, the temperature of the fuse wire increases. This melts the fuse wire and breaks the circuit. These wires are used for making electric fuses. In all buildings, fuses are inserted into all electrical circuits. There is a maximum limit on the current which can safely flow through a circuit. If the current exceeds this safe limit by accident, the wires may become overheated and cause a fire. If a proper fuse is present in the circuit, it will blow off and break the circuit. Thus, a fuse is a safety device that prevents damage to electrical circuits and possible fires. **So, Statement 2 is correct.**

80. Consider the following statements regarding Thalassemia :
    1. It is an inherited blood disorder that causes a body to have less haemoglobin than normal.
    2. Thalassemia disease can be treated by a bone marrow transplant.

    Which of the above statements is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) Both 1 and 2
    (d) Neither 1 nor 2

EXPLANATION:

Thalassemia is an inherited blood disorder that causes your body to produce less haemoglobin than normal. Haemoglobin is a protein in red blood cells that helps them carry oxygen to all parts of the body. Haemoglobin is made of two kinds of protein chains called alpha globin and beta globin.
Thalassemia develops when faulty genes prevent the body from making the right amount of alpha-globin or beta-globin chains, so red blood cells cannot carry enough oxygen to your body's organs and tissues.
If one inherits faulty haemoglobin genes from one parent but normal genes from the other, you are called a "carrier." Carriers often have no signs of illness, or they may experience mild anaemia. However, they can pass the faulty genes on to their children. If you inherit faulty genes from both parents, your disease may be moderate to serious. The two types of thalassemia are alpha thalassemia and beta thalassemia. **So, Statement 1 is correct.**

Stem cell or bone marrow transplants are the only cure for thalassaemia. Stem cells are produced in bone marrow, the spongy tissue found in the centre of some bones, and have the ability to develop into different types of blood cells. For a stem cell transplant, stem cells from a healthy donor are given through a drip into a vein. These cells then start to produce healthy red blood cells to replace the cells affected by thalassaemia.
A stem cell transplant is an intensive treatment that carries a number of risks. The main risk is graft versus host disease, which is a life-threatening problem where the transplanted cells start to attack the other cells in your body. For people with serious types of thalassaemia, the long-term benefits of a stem cell transplant will need to be considered against the possible risks to help determine whether the treatment is suitable. **So, Statement 2 is correct.**

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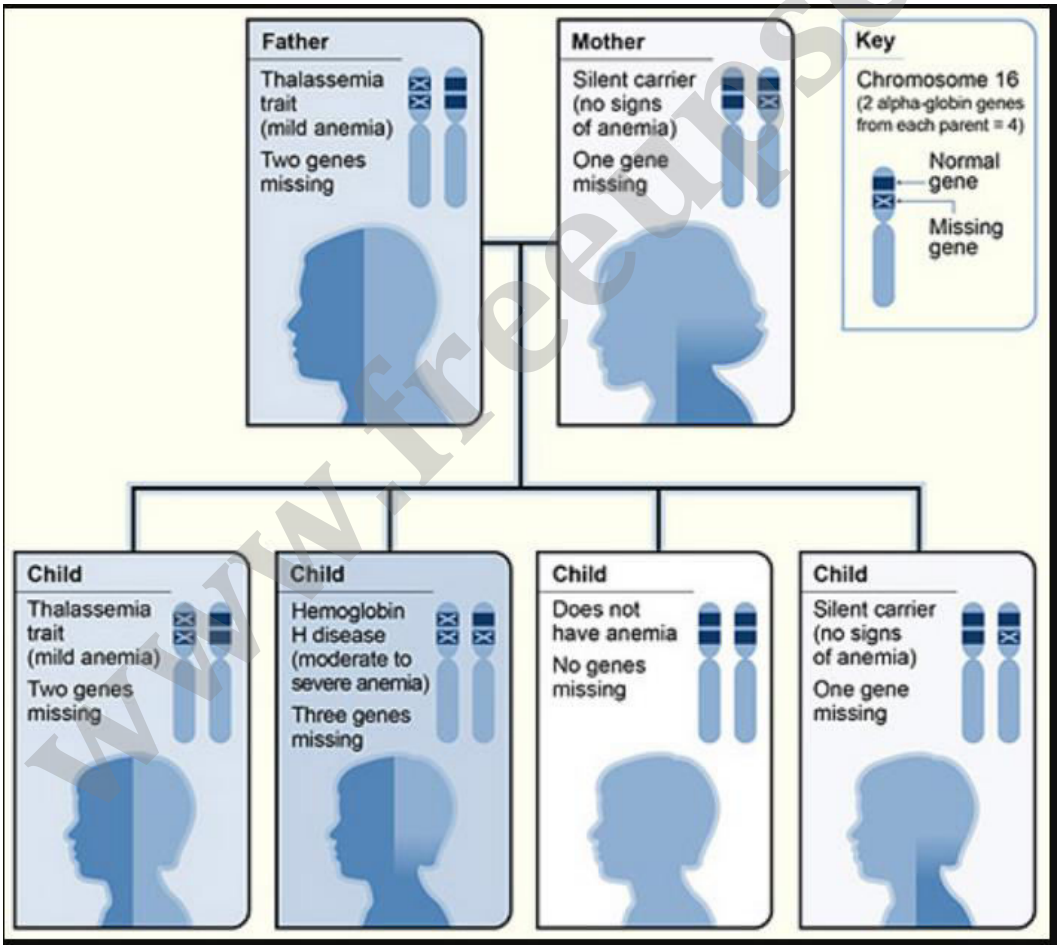
ADDITIONAL INFORMATION:

THALASSEMIA DISEASE	
Recently in news	International Thalassemia Day: Union Health Secretary stresses on importance of timely detection and prevention for addressing Thalassemia.
How Does Alpha Thalassemia Develop	One need four genes (two from each parent) to make enough alpha globin protein chains. If one or more of the genes is missing, one will have alpha thalassemia, which means the body does not make enough alpha globin protein. ➢ If there is only missing one gene, they are a "silent" carrier. This means the person won't have any signs of illness. ➢ If there are two genes missing, then its alpha thalassemia trait (also called alpha thalassemia minor). This means the person may have mild symptoms of anemia. ➢ If there are three genes missing, one likely have hemoglobin H disease (which a blood test can detect). This type of thalassemia causes moderate to severe anemia. ➢ Very rarely, a baby is missing all four genes. This condition is called alpha thalassemia major or hydrops fetalis. Babies who have hydrops fetalis usually die before or shortly after birth. 

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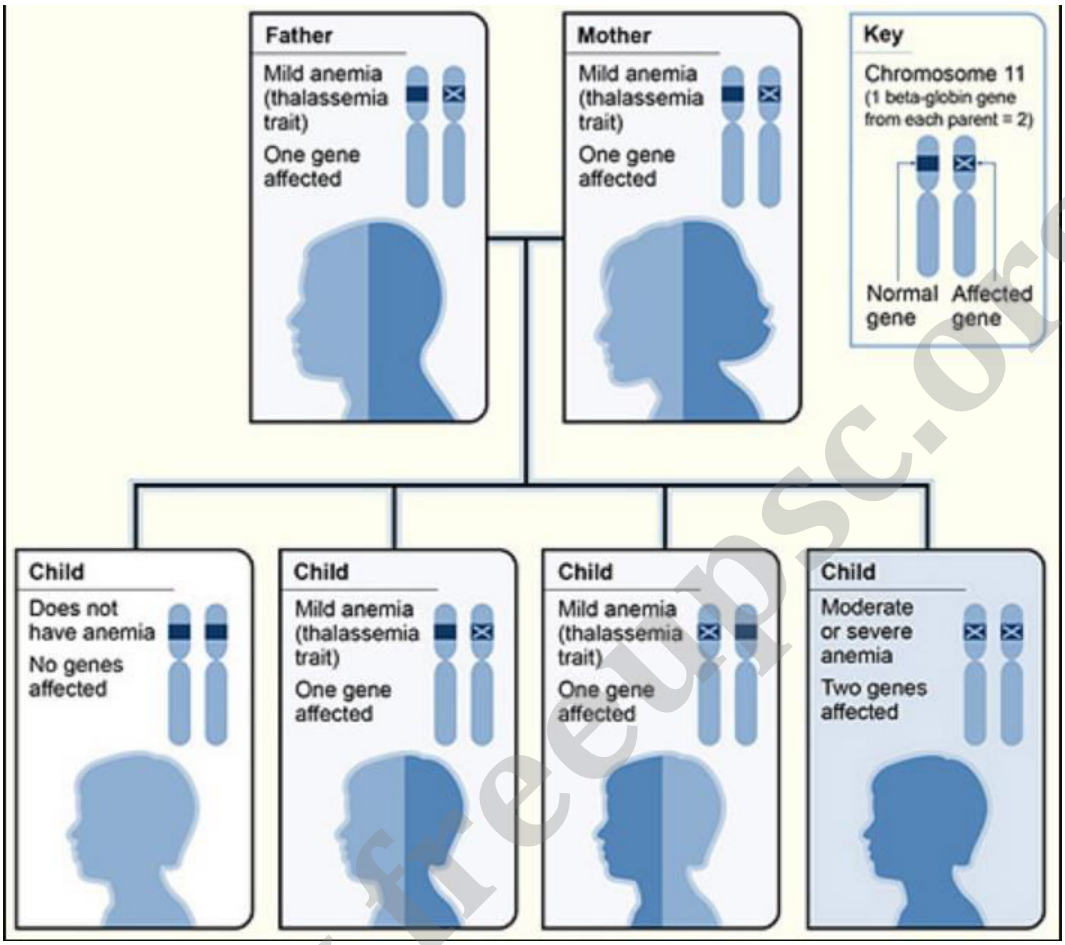
How Does Beta Thalassemia Develop	You need two genes (one from each parent) to make enough beta globin protein chains. If one or both of these genes are altered, you'll have beta thalassemia. This means that your body won't make enough beta globin protein. ➢ If you have one altered gene, you're a carrier. This condition is called beta thalassemia trait or beta thalassemia minor. It causes mild anemia symptoms. ➢ If both genes are altered, you'll have beta thalassemia intermedia or beta thalassemia major (also called Cooley's anemia). The intermedia form of the disorder causes moderate anemia. The major form causes serious anemia symptoms. 

81. Consider the following statements :
    1. Methane is the second most abundant anthropogenic greenhouse gas after carbon dioxide.
    2. Methanogens play a crucial role in the global carbon cycle by converting organic matter into methane.
    3. If the methane is from a biological source, there will be more carbon-13 atoms in 1000 molecules.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) **1 and 2 only**
    (c) 2 and 3 only
    (d) 1, 2 and 3

EXPLANATION:

Methane (CH_4) is a hydrocarbon that is a primary component of natural gas. Methane is also a greenhouse gas (GHG), so its presence in the atmosphere affects the earth's temperature and climate system. Methane is emitted from a variety of anthropogenic (human-influenced) and natural sources. Anthropogenic

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emission sources include landfills, oil and natural gas systems, agricultural activities, coal mining, stationary and mobile combustion, wastewater treatment, ands certain industrial processes. Methane is the second most abundant anthropogenic GHG after carbon dioxide (CO_2), accounting for about 16 per cent of global emissions. Methane is more than 28 times as potent as carbon dioxide at trapping heat in the atmosphere. **So, Statement 1 is correct.**
Methane-producing archaea, or methanogens, are characterized by their ability to conserve energy for ATP (adenosine triphosphate) synthesis by producing methane gas. Methanogens play an essential role in the global carbon cycle by serving as terminal organisms in anaerobic microbial food chains that convert complex organic matter to Methane (CH_4) and (CO_2). They utilize simple molecules for growth that include acetate and several one-carbon compounds. Although first reported in 1931, comparatively little is known today of the ecology, physiology, and biochemistry of CO utilization by methanogens. **So, Statement 2 is correct.**
The sources of methane, most of which fit into two categories: biogenic and thermogenic. When fossil fuels such as natural gas or oil are extracted from deep within the earth's crust, thermogenic methane is released. Biogenic methane comes from microbial action. If there are fewer carbon-13 atoms than a certain level in a group of 1,000 methane molecules, the methane is from a biological source. If the methane is from thermogenic sources, such as trapped fossil fuels or geological activities, there will be more carbon-13 atoms in 1,000 molecules. Both biogenic and thermogenic activities produce different isotopes of methane. Tracking the isotopes is a way to track the most active sources. Hence, the given statement is related to thermogenic activity. **So, Statement 3 is not correct.**

ADDITIONAL INFORMATION:

GREENHOUSE GASES	
Recently in news	An intensive modelling study found that methane emissions from fossil fuels declined bestween 1990 and the 2000s and have been stable since, whereas microbes have produced more methane later.
About	Some greenhouse gases are emitted exclusively from human activities (e.g., synthetic halocarbons). Others occur naturally but are found at elevated levels due to human inputs (e.g., carbon dioxide). Anthropogenic sources result from energy-related activities (e.g., combustion of fossil fuels in the electric utility and transportation sectors), agriculture, land-use change, waste management and treatment activities, and various industrial processes. ➢ Major greenhouse gases include carbon dioxide, methane, nitrous oxide, and various synthetic chemicals. ➢ Carbon dioxide is widely reported as the most important anthropogenic greenhouse gas because it currently accounts for the greatest portion of the warming associated with human activities. Carbon dioxide occurs naturally as part of the global carbon cycle, but human activities have increased atmospheric loadings through combustion of fossil fuels and other emissions sources. Natural sinks that remove carbon dioxide from the atmosphere (e.g., oceans, plants) help regulate carbon dioxide concentrations, but human activities can disturb these processes (e.g., deforestation) or enhance them. ➢ Methane comes from many sources, including human activities such as coal mining, natural gas production and distribution, waste decomposition in landfills, and digestive processes in livestock and agriculture. Natural sources of methane include wetlands and termite mounds. ➢ Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels. ➢ Various synthetic chemicals, such as hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other synthetic gases, are released as a result of commercial, industrial, or household uses.

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82. Consider the following statements :
    1. Neutron stars are extremely dense, which creates immense pressure that forces the neutrons into a quark matter.
    2. Unlike electrons, protons and neutrons are composite particles made up of quarks.

    Which of the statements given above is/are correct ?
    (a) 1 only
    (b) 2 only
    (c) **Both 1 and 2**
    (d) Neither 1 nor 2

EXPLANATION:

Neutron stars are the final stage in the curve of evolution of very massive stars which are around two times as massive as the Sun. Initially, the stars glow and burn up their fuel. Due to internal pressure building up, they expand, and since their mass is so high, they actually undergo a supernova explosion, throwing out the outer layers into Space. The inner core collapses under its own gravity, shrinking to a small size of a few tens of kilometres in diameter. It stops short of becoming a black hole, as the mass is not sufficient to enable that.

- The matter inside neutron stars is extremely dense. For example, two Suns' worth of mass is packed into a sphere only 25 km wide. This creates an immense pressure that could be forcing the neutrons into a new state of matter. This state could be quark matter when there are no longer any neutrons, only quarks.
- In December 2023, researchers from the University of Helsinki reported in the journal Nature Communications that the insides of most massive neutron stars have an 80-90% chance of being made of quark matter. **So, Statement 1 is correct.**

We know that all matter is composed of atoms, and atoms are made of protons and neutrons inside the nucleus and electrons outside. But unlike electrons and protons, neutrons are composite particles because they are further made up of quarks. Quarks can't exist in isolation. They can only be found in groups of two or three, if not more. Such clumps of quarks are called hadrons. Protons and neutrons are common examples. Physicists have mostly studied quarks based on the behaviour of hadrons and are also interested in how quarks clump together. **So, Statement 2 is correct.**

ADDITIONAL INFORMATION:

ATOMIC STRUCTURE	
About	➢ Atoms are the basic units of matter. Everything in the universe apart from energy is made of matter therefore, atoms make up everything in the universe. ➢ Atoms were created after the Big Bang 13.7 billion years ago. As the hot, dense new universe cooled, conditions became suitable for quarks and electrons to form. ➢ Quarks came together to form protons and neutrons, and these particles combined into nuclei. This all took place within the first few minutes of the universe's existence.
Electrons	➢ Electrons are one of three main types of particles that make up atoms. Electrons are extremely small. ➢ The mass of an electron is only about 12000, the mass of a proton or neutron, so electrons contribute virtually nothing to the total mass of an atom. Electrons have an electric charge of 1–, which is equal to but opposite to the charge of a proton, which is 1+. ➢ All atoms have the same number of electrons as protons, so the positive and negative charges "cancel out", making atoms electrically neutral. ➢ While protons and neutrons are located inside the nucleus at the centre of the atom, electrons are located outside the nucleus in what is often called the electron cloud.
Protons	➢ A proton is another one of the three main particles that make up the atom. Protons are found in the nucleus of the atom – the tiny, extremely dense region at the centre of the atom. ➢ Protons have a positive electrical charge of one (1+) and a mass of about 1 atomic

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	mass unit (1 amu). Together with neutrons, they make up virtually all of the mass of an atom.
Neutrons	➢ The last of the three main particles that make up the atom is the neutron. Atoms of all elements (except for most atoms of hydrogen) have neutrons in their nucleus. ➢ Unlike protons and electrons, which are electrically charged, neutrons have no charge – they are electrically neutral. The zero stands for "zero charge". ➢ A neutron is slightly more massive than a proton (see below) and has about the same diameter. Neutrons are found in all atoms (except for most atoms of hydrogen) and may be found bound together with other neutrons and protons in the atomic nucleus. ➢ Since protons and neutrons are so much more massive than electrons, almost all of the mass of an atom comes from the nucleus, which contains all of the neutrons and protons.

83. Consider the following statements :

Statement-I :

X-rays are capable to scan the inside of the human body.

Statement-II :

X-rays have wavelengths between 0.01 to 10 nanometers, small enough to pass between atoms in many materials.

Statement-III :

Dense materials like bones reflect more X-rays and appear white on images.

Which one of the following is correct in respect of the above statements ?

(a) Both Statement-II and Statement-III are correct and both of them explain Statement-I

(b) Both Statement-II and Statement-III are correct, but only one of them explains Statement-I

(c) Only one of the Statements II and III is correct and that explains Statement-I

(d) Neither Statement-II nor Statement-III is correct

EXPLANATION:

X-rays are a type of radiation called electromagnetic waves. X-ray imaging creates pictures of the inside of your body. The images show the parts of your body in different shades of black and white. This is because different tissues absorb different amounts of radiation. Calcium in bones absorbs x-rays the most, so bones look white. Fat and other soft tissues absorb less and look gray. Air absorbs the least, so lungs look black.

X-rays covers wavelengths from about 10–8 m (10 nm) down to 10–13 m (10–4 nm). One common way to generate X-rays is to bombard a metal target by high energy electrons. X-rays are used as a diagnostic tool in medicine and as a treatment for certain forms of cancer. Because X-rays damage or destroy living tissues and organisms, care must be taken to avoid unnecessary or over exposure.

The most familiar use of x-rays is checking for fractures (broken bones), but x-rays are also used in other ways. For example, chest x-rays can spot pneumonia. Mammograms use x-rays to look for breast cancer.

Only one of the Statements II and III is correct and that explains Statement-I

84. Consider the following pairs :

	Tradition		***State***
1.	Ambubachi Mela	-	Assam
2.	Raja Parba festival	-	Gujarat
3.	Mata ni pachedi paintings	-	Odisha

How many of the above pairs are correctly matched ?

(a) Only one

(b) Only two

(c) All three

(d) None

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EXPLANATION:

The Ambubachi Mela is an annual Hindu religious festival held in the Kamakhya Temple of Guwahati, Assam. It is one of the biggest congregations of eastern India. It is the most important festival of the Kamakhya temple and is celebrated in the month of June every year. The festival has been associated with fertility rituals, and many devotees come to seek the blessing of a child from the Goddess. The temple has courted controversy because of the alleged tantric activities conducted during this mela. During the festival, the patron Goddess Kamakhya is said to be undergoing her annual menstrual cycle. Hence the temple remains closed for three days. **So, Pair (1) is correct.**

Raja Parba is an annual festival celebrated in Odisha. This is a three-day-long festival dedicated to Mother Earth (Bhuma Devi) and womanhood at large.

The first day of the festival is called Pahili Raja, and the second is Mithuna Sankranti, and the third is Bhu daha or Basi Raja. The preparation begins one day before Pahili Raja, and it is called Sajabaja. Primarily, it is a time for unmarried girls to prepare for their matrimony. They follow various customs related to the festival by consuming nutritious food like Podapitha, not walking barefoot, taking a bath on the first day, and merrily swinging on ropes attached to a tree. Thus, The Raja Parba festival is not related to Gujarat. **So, Pair (2) is not correct.**

Mata Ni Pachedi (Ritual Cloth Painting) is a traditional folk art form orginated from Gujarat. Mata Ni Pachedi art literally means "behind the Mother Goddess". This textile-painting form generally depicts images of the temple of the Mother Goddess on cloth. Due to its similarity with the Kalamkari art of South India, Mata Ni Pachedi art is also known as Kalamkari of Gujarat. Thus, the Mata Ni Pachedi is not related to Odisha. **So, Pair (3) is not correct.**

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ADDITIONAL INFORMATION:

FESTIVALS	
Assam	Bihu Ambubachi Mela Majuli Bohag Baishagu festival
Gujarat	Navratri Uttarayana Modhera Dance Kite Festival Saptak Music Festival
Odisha	Nuakhai Konark Festival International sand art festival

85. Which of the following properties does Graphene, a 2-dimensional material, lack, posing a significant challenge to its use as a traditional semiconductor ?
(a) Flexibility
(b) Mechanical strength
(c) Natural Bandgap
(d) Electrical conductivity

EXPLANATION:

- Graphene, a two-dimensional form of crystalline carbon, either a single layer of carbon atoms forming a honeycomb (hexagonal) lattice or several coupled layers of this honeycomb structure. Graphene is a parent form of all graphitic structures of carbon,
- In most semiconductors there are certain energy levels where electrons and holes do not have allowed quantum states, and, because electrons and holes cannot occupy these levels, for certain gate voltages and types of chemical doping, the semiconductor acts as an insulator.
- Graphene, on the other hand, does not have an insulator state, and conductivity remains finite at any doping, including zero doping. Existence of this minimal conductivity for the undoped case is a striking difference between graphene and conventional semiconductors.
- Unlike conventional semiconductors, graphene lacks an intrinsic electron bandgap. This is an energy barrier that electrons must overcome to conduct electricity. It is the bandgap that allows electronic switches (transistors) to be made from semiconductors.
- Therefore, Graphene lacks a natural bandgap that poses a significant challenge to use as a traditional semiconductor.**So,Option (c) is correct.**

ADDITIONAL INFORMATION:

GRAPHENE	
Nature	Graphene is a two-dimensional material consisting of a single layer of carbon atoms arranged in a honeycomb structure. Its properties include high strength and good conductivity of heat and electricity. The stacked form of graphene is graphite. This material has superlative properties of strength, elasticity, electrical conductivity, and thermal conductivity. It can potentially provide a higher energy density than that of a common supercapacitor.
Applications	Graphene has a wide range of potential applications and uses due to its exceptional mechanical, electrical, and thermal properties. It is used in electronics, energy storage, sensors, coatings, composites, biomedical devices and many other. Its high surface area and biocompatibility make it an attractive material for drug delivery and tissue

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	engineering applications. Graphene's unique properties make it a promising material for many future technologies. ➢ Graphene in Solar Cells ➢ Graphene Batteries ➢ Graphene in Nuclear Power Plants ➢ Graphene in Thermoelectric ➢ Graphene in Alcohol Distillation ➢ Graphene in Fuel Cells ➢ Graphene UV Sensors,etc...
About	Among the diverse properties of Graphene, the ones that stand out most are its high thermal and electrical conductivity, elasticity, toughness, lightness, and resistance. These characteristics could be of great use for innovation in different sectors and represent a real revolution. High conductivity ➢ Through the use of graphene, the useful life of batteries could be increased by 10, as well as charging in less time, which translates into an autonomy improvement. It's only a matter of time before graphene replaces a large part of the lithium batteries currently in use. Lightness ➢ Graphene is also suitable for manufacturing batteries for drones, as these would be lighter and tougher. Let's remember that these pieces that accumulate energy are some of the heaviest in technology and reducing their weight could be a great innovation. With the application of graphene, one of the greatest limitations that drones present today is minimized. Transparency and flexibility ➢ Graphene is a transparent material and absorbs very little light (only 2%). Thanks to that and its flexibility, flexible screens could be manufactured for all types of devices. Furthermore, graphene can be folded like cling film, so the chances of breakage are much lower. It could be applied in the manufacturing of cellphones, televisions, vehicles, etc High resistance ➢ As well as being an excellent electric conductor, graphene is a very resistant material, so big advances in the lighting sector are expected. For example, graphene light bulbs could increase the useful life of each globe and consume less energy than the LED lights that we currently have.

86. If a large asteroid were to impact the Earth, which of the following are the possible effects on the Earth ?
    1. Generation of massive tsunamis
    2. Mass Extinction event
    3. Large-scale wildfires
    4. Impact winter

    Select the correct codes from the options given below :

    (a) 1 and 2 only
    (b) 1, 2 and 3 only
    (c) 2 and 4 only
    (d) **1, 2, 3 and 4**

EXPLANATION:

Calculations can be made and scaled experiments can be conducted to estimate the effects of an impact of a large meteorite (> 1 km in size) or comet. The general consensus is summarized here.

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- Generation of massive tsunamis: Large asteroid were to impact the Earth, if the impact occurred in the oceans, giant tsunami would be generated. For a 10 km-diameter object the leading edge would hit the seafloor of the deep ocean basins before the top of the object had reached sea level. The tsunami from such an impact is estimated to produce waves from 1 to 3 km high. These could easily flood the interior of continents. **So, Statement 1 is correct.**
- The effects of an impact on the earth depends critically on the size, and hence the energy, of the impact. For example, a comet less than 100 meters across will explode high in the atmosphere and probably do no harm whatsoever. If the comet is 10 kilometres across or larger, the resulting global environmental damage will be so extensive that it will lead to a mass extinction, in which most life forms die. This is what happened 65 million years ago at the end of the Cretaceous era, when the dinosaurs went extinct. **So, Statement 2 is correct.**
- Large-scale wildfires: Widespread wildfires ignited by radiation from the fireball as the object passed through the atmosphere would be generated. Smoke from these fires would further block solar radiation to enhance the cooling effect and further disrupt photosynthesis. **So, Statement 3 is correct.**
- Impact winter: The large quantities of dust put into the atmosphere would block incoming solar radiation. The dust could take months to settle back to the surface. Meanwhile, the Earth would be in a state of continual darkness, and temperatures would drop throughout the world, generating global winter like conditions. A similar effect has been postulated for the aftermath of a nuclear war (termed a nuclear winter). Blockage of solar radiation would also diminish the ability of photosynthetic organisms, like plants, to photosynthesize. Since photosynthetic organisms are the base of the food chain, this would seriously disrupt all ecosystems. **So, Statement 4 is correct.**
- Massive earthquake - up to Richter Magnitude 13, and numerous large magnitude aftershocks would result from the impact of a large object with the Earth.
- Green house effect: If the impact occurred in the oceans, a large steam cloud would be produced by the sudden evaporation of the seawater. This water vapour and CO_2 would remain in the atmosphere long after the dust settles. Both of these gases are greenhouse gases which scatter solar radiation and create a warming effect. Thus, after the initial global cooling, the atmosphere would undergo global warming for many years after the impact.
- Acid Rain: Large amounts of nitrogen oxides would result from combining Nitrogen and Oxygen in the atmosphere due to the shock produced by the impact. These nitrogen oxides would combine with water in the atmosphere to produce nitric acid which would fall back to the surface as acid rain, resulting in the acidification of surface waters.

ADDITIONAL INFORMATION:

METEORS AND ASTEROIDS	
About	Asteroid: An asteroid is a small rocky body that orbits the Sun. ➢ Meteoroids: Sometimes one asteroid can smash into another. This can cause small pieces of the asteroid to break off. Those pieces are called meteoroids. Meteoroids can also come from comets. ➢ Meteor: If a meteoroid comes close enough to Earth and enters Earth's atmosphere, it vaporizes and turns into a meteor: a streak of light in the sky. Because of their appearance, these streaks of light are sometimes called "shooting stars." But meteors are not actually stars. ➢ Comets: Comets orbit the Sun, like asteroids. But comets are made of ice and dust—not rock. ➢ Sometimes meteoroids don't vaporize completely in the atmosphere. In fact, sometimes they survive their trip through Earth's atmosphere and land on the Earth's surface. When they land on Earth, they are called meteorites.

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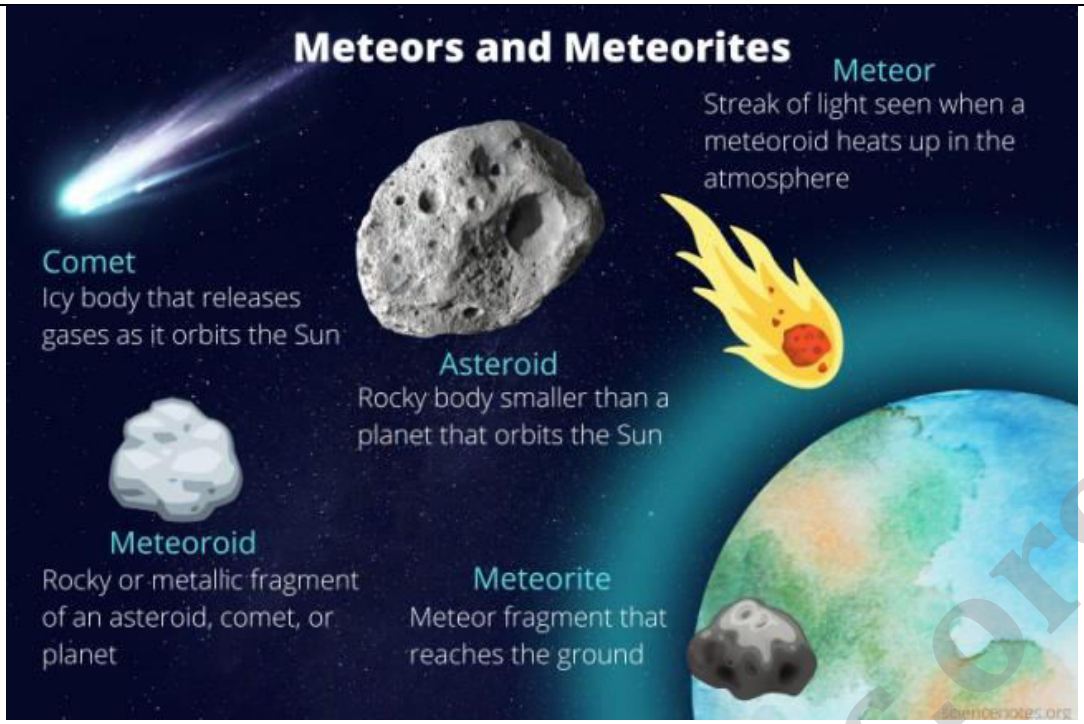
Meteors and Meteorites
Meteor
Streak of light seen when a meteoroid heats up in the atmosphere
Comet
Icy body that releases gases as it orbits the Sun
Asteroid
Rocky body smaller than a planet that orbits the Sun
Meteoroid
Rocky or metallic fragment of an asteroid, comet, or planet
Meteorite
Meteor fragment that reaches the ground

87. Consider the following pairs :

	Satellites / Telescopes		***Description***
1.	PRATUSH	-	Radiometer in lunar orbit that will reveal the Cosmic Dawn of our Universe.
2.	Long-Baseline Optical Imaging Interferometer	-	Study magnetic activity on stars and the centres of active galaxies in visible and ultraviolet wavelengths.
3.	Queqiao-2	-	Relay satellite to support communications with the current Chang'e-4 mission

Which of the pairs given above are correct ?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) **1, 2 and 3**

EXPLANATION:

PRATUSH (Probing ReionizATion of the Universe using Signal from Hydrogen) is a radio telescope, to be sited on the moon's far side. PRATUSH is being built by the Raman Research Institute (RRI) in Bengaluru with active collaboration from the Indian Space Research Organisation (ISRO). PRATUSH is a future radiometer in lunar orbit that will reveal the Cosmic Dawn of our Universe. PRATUSH will discover answer to the question of when the first stars formed in our universe, the nature of the first stars, and what was the light from the first stars or, in other words, the colour of the light of Cosmic Dawn. **So, Pair 1 is correct.**

NASA's Long-Baseline Optical Imaging Interferometer will study magnetic activity on stars and the centres of active galaxies in visible and ultraviolet wavelengths. Study of Lunar surface-based interferometer will be a huge step forward to larger arrays on both the moon and free-flying in space. It will determine, given the current and anticipated state of our space technology and human exploration plans. **So, pair 2 is correct**.

Queqiao-2 (Magpie Bridge 2) is a relay satellite designed to go into lunar orbit and support

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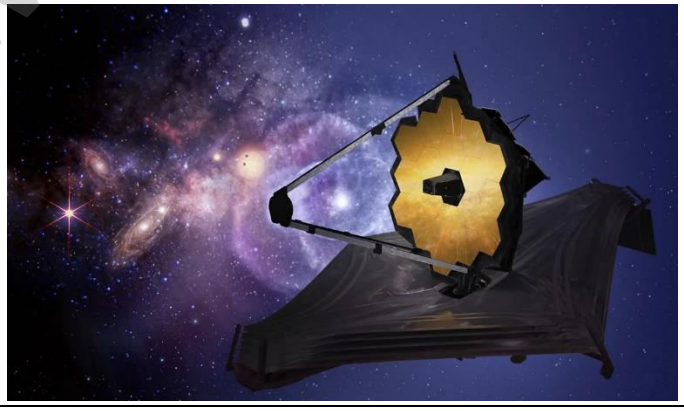
communications with the current Chang'e-4 mission and the future Chang'e-6, -7, and -8 missions. It launched on a Long March 8 rocket from Wenchang, China with a planned lifetime of over 8 years. The satellite is a larger version of the first Queqiao relay satellite, based on the CAST 2000 bus, with a mass of 1200 kg. Queqiao 2 carries three science payloads: an Extreme Ultraviolet Camera (EUC), a Grid-based Energetic Neutral Atom imager (GENA), and a very long baseline interferometer, the Lunar Orbit VLBI EXperiment (LOVEX). **So, Pair 3 is correct**.

ADDITIONAL INFORMATION:

SATELLITES/TELESCOPES	
Hubble Space Telescope	➢ The Hubble Space Telescope is a large, space-based observatory that has changed our understanding of the cosmos since its launch and deployment by the space shuttle Discovery in 1990. ➢ Telescopes have a particular range of light that they can detect. Hubble's domain extends from the ultraviolet through the visible (which our eyes see) and into the near-infrared. This range has allowed Hubble to deliver stunning images of stars, galaxies, and other astronomical objects that have inspired people around the world. ➢ Hubble has made more than 1.6 million observations over the course of its lifetime.
James webb space telescope	➢ Webb studies every phase in the history of our Universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own Solar System. ➢ It does not orbit around the Earth like the Hubble Space Telescope, it orbits the Sun 1.5 million kilometers (1 million miles) away from the Earth at what is called the second Lagrange point or L2. 

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88. With reference to the Prime Minister's National Relief Fund (PMNRF), consider the following statements :
    1. PMNRF was originally established to offer immediate relief during natural calamities.
    2. In addition to public contributions, PMNRF also receives support from the annual budget.
    3. All contributions to the PMNRF are exempt from Income Tax.

    Which of the above statements is/are not correct ?
    (a) 1 only
    (b) 1 and 2 only
    (c) 3 only
    (d) 2 and 3 only

EXPLANATION:

In pursuance of an appeal by the then Prime Minister, Pt. Jawaharlal Nehru in January, 1948, the Prime Minister's National Relief Fund (PMNRF) was originally established with public contributions to assist displaced persons from Pakistan. Prime Minister is the Chairman of PMNRF and is assisted by Officers/ Staff on honorary basis. The resources of the PMNRF are now utilized primarilys to render immediate relief to families of those killed in natural calamities like floods, cyclones and earthquakes, etc. and to the victims of the major accidents and riots. Thus, PMNRF was originally established not to offer immediate relief during natural calamities**. So, Statement 1 is not correct.**
Prime Minister's National Relief Fund (PMNRF) was established entirely with public contributions and does not get any budgetary support. Contributions flowing out of budgetary sources of Government or from the balance sheets of the public sector undertakings are not accepted. Conditional contributions, where the donor specifically mentions that the amount is meant for a particular purpose, are not accepted in the Fund. **So, Statement 2 is not correct.**
PMNRF is exempt under Income Tax Act, 1961 under Section 10 and 139 for return purposes. Contributions towards PMNRF are notified for 100% deduction from taxable income under section 80(G) of the Income Tax Act, 1961. In case the donor deposits donations directly in any of the PMNRF collection banks, they are advised to provide complete transaction details along with their address to this office through e-mail in for speedy issue of 80(G) Income Tax Receipts. **So, Statement 3 is correct.**

ADDITIONAL INFORMATION:

TAX EXEMPTION FUNDS IN INDIA	
Recently in News	Tamil Nadu MPs to call on Union Home Minister to seek **Prime Minister's National Relief Fund.**
Public Provident Fund (PPF)	➢ An individual can save income tax under Section 80C by investing in the Public Provident Fund (PPF). ➢ This small saving scheme has the "exempt-exempt-exempt" or EEE status. ➢ This means that the individual can claim a deduction on the amount invested and not pay tax on the interest earned as well as the maturity amount.
Sukanya Samriddhi Yojana (SSY)	➢ The Sukanya Samriddhi Yojana (SSY) was introduced under the government's "Beti Bachao, Beti Padhao" scheme. ➢ This is a deposit scheme for girl children. It allows the parents to invest for the education or marriage of a girl child and at the same time claim income tax benefit.
Employees Provident Fund (EPF)	➢ Salaried individuals covered under the Employees Provident Fund (EPF) mandatorily deposit 12% of their salary in the EPF account. ➢ The scheme has a lock-in period till the age of retirement. ➢ However, the scheme allows premature withdrawals for certain situations such as for higher education, marriage and treatment of illness, among others. ➢ The EPF scheme has EEE tax status subject to certain conditions.

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ELSS mutual funds	➢ ELSS stands for equity-linked savings scheme. ➢ These are the mutual fund schemes that invest in equities and offer tax-saving benefits. An individual can claim tax benefit up to Rs 1.5 lakh under Section 80C.

89. Consider the following statements :
1. A Geomagnetic storm happens when the particles from the Sun interact with the Earth's magnetic field.
2. Coronal Mass Ejections (CMEs) are large clouds of plasma and magnetic fields hurled into space from the Sun.

Which of the statements given above is/are correct ?
(a) 1 only
(b) 2 only
(c) **Both 1 and 2**
(d) Neither 1 nor 2

EXPLANATION:

A geomagnetic storm is a major disturbance of Earth's magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth. These storms result from solar wind variations that produce major changes in the currents, plasmas, and fields in Earth's magnetosphere.
The solar wind conditions that are effective for creating geomagnetic storms are sustained (for several to many hours) periods of high-speed solar wind and, most importantly, a southward-directed solar wind magnetic field (opposite the direction of Earth's field) at the dayside of the magnetosphere. This condition effectively transfers energy from the solar wind into Earth's magnetosphere. **So, Statement 1 is correct.**

The coronal Mass Ejections (CMEs) are large expulsions of plasma and magnetic fields from the Sun's corona. They can eject billions of tons of coronal material and carry an embedded magnetic field (frozen in flux) that is stronger than the background solar wind interplanetary magnetic field (IMF) strength. CMEs travel outward from the Sun at speeds ranging from slower than 250 kilometres per second (km/s) to as fast as near 3000 km/s.
The fastest Earth-directed CMEs can reach our planet in as little as 15-18 hours. Slower CMEs can take several days to arrive. They expand in size as they propagate away from the Sun, and larger CMEs can reach a size comprising nearly a quarter of the space between Earth and the Sun by the time it reaches our planet. **So, Statement 2 is correct.**

ADDITIONAL INFORMATION:

GEOMAGNETIC STORMS AND CORONAL MASS EJECTIONS	
Geomagnetic Storms	➢ The largest storms resulting from the solar wind conditions that are effective for creating geomagnetic storms are associated with solar coronal mass ejections (CMEs), where a billion tons of plasma from the Sun, with its embedded magnetic field, arrives at Earth. CMEs typically take several days to arrive on Earth but have been observed, for some of the most intense storms, to arrive in as short as 18 hours. ➢ Another solar wind disturbance that creates conditions favourable to geomagnetic storms is a high-speed solar wind stream (HSS). ➢ HSSs flow into the slower solar wind in front, creating co-rotating interaction regions or CIRs. These regions are often related to geomagnetic storms that, while less intense than CME storms, often can deposit more energy in Earth's magnetosphere over a longer interval. ➢ Storms also result in intense currents in the magnetosphere, changes in the radiation belts, and changes in the ionosphere, including heating the ionosphere and

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	upper atmosphere region called the thermosphere. ➢ In space, a ring of westward current around Earth produces magnetic disturbances on the ground. A measure of this current, the disturbance storm time (Dst) index, has been used historically to characterize the size of a geomagnetic storm. ➢ In addition, there are currents produced in the magnetosphere that follow the magnetic field, called field-aligned currents, and these connect to intense currents in the auroral ionosphere. These auroral currents, called the auroral electrojets, also produce large magnetic disturbances. Together, all of these currents and the magnetic deviations they produce on the ground are used to generate a planetary geomagnetic disturbance index called Kp. This index is the basis for the Space Weather Scales, the Geomagnetic Storm, or G-Scale, which is used to describe space weather that can disrupt systems on Earth.
Coronal Mass Ejections (CME)	➢ Imminent CME arrival is first observed by the Deep Space Climate Observatory (DSCOVR) satellite, located at the L1 orbital area. Sudden increases in density, total interplanetary magnetic field (IMF) strength, and solar wind speed at the DSCOVR spacecraft indicate the arrival of the CME-associated interplanetary shock ahead of the magnetic cloud. This can often provide 15 to 60 minutes advanced warning of shock arrival at Earth – and any possible sudden impulse or sudden storm commencement, as registered by Earth-based magnetometers. ➢ The more explosive CMEs generally begin when highly twisted magnetic field structures (flux ropes) contained in the Sun's lower corona become too stressed and realign into a less tense configuration – a process called magnetic reconnection. This can result in the sudden release of electromagnetic energy in the form of a solar flare, which typically accompanies the explosive acceleration of plasma away from the Sun – the CME. ➢ These CMEs usually occur from areas of the Sun with localized fields of strong and stressed magnetic flux, such as active regions associated with sunspot groups. ➢ CMEs can also occur from locations where relatively cool and denser plasma is trapped and suspended by magnetic flux extending up to the inner corona - filaments and prominences. ➢ Important aspects of an arriving CME and its likelihood of causing more intense geomagnetic storming include the strength and direction of the IMF beginning with shock arrival, followed by arrival and passage of the plasma cloud and frozen-in-flux magnetic field.

90. With reference to reflecting telescopes, consider the following statements :
    1. In reflecting telescopes, mirrors produce spherical aberration where the reflected light rays converge at separate focal points.
    2. In such a telescope, the objective mirror focuses light inside the telescope tube.
    3. The Sampurnanand Telescope at the Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, is the largest reflecting telescope in India for the study of celestial objects at optical wavelengths.

    How many of the above statements are correct?
    (a) Only one
    (b) Only two
    (c) All three
    (d) None

EXPLANATION:

A telescope that uses a mirror as its primary optical element is called a reflecting telescope. Large mirrors can be made thinner and lighter than lenses of the same size, which makes reflecting scopes ideal for

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sending to space. A reflecting telescope is used to see distant stars and possesses large light-gathering power in order to obtain a bright image of even a faint star deep in space.
Spherical aberration is when the mirror's centre and edge do not have equal distances from the mirror's focus point, causing reflected light rays to converge at separate focul points, leading to blurry image. Hence reflected light rays converge at separate focal points when mirrors produce spherical aberration. **So, Statement 1 is correct**.

One major problem with the reflecting telescope is that the objective mirror focusses light inside the telescope tube. One must have an eyepiece and the observer right there, obstructing some light (depending on the size of the observer cage). The solution to the problem is to deflect the light being focussed by another mirror. One such arrangement using a convex secondary mirror to focus the incident light, which now passes through a hole in the objective primary mirror. This is known as a Cassegrain telescope, after its inventor. It has the advantages of a large focal length in a short telescope. The largest telescope in India is in Kavalur, Tamil Nadu. It is a 2.34 m diameter reflecting telescope (Cassegrain). It was ground, polished, set up, and is being used by the Indian Institute of Astrophysics, Bangalore. The largest reflecting telescopes in the world are the pair of Keck telescopes in Hawaii, USA, with a reflector of 10 metre in diameter. **So, Statement 2 is correct.**

The 3.6m Devasthal Optical Telescope (Not the Sampurnanand Telescope) is a custom-built instrument of great complexity. This telescope has the distinction of being the largest reflecting telescope in India for the study of celestial objects at optical wavelengths. It was commissioned in the year 2016 and is being maintained and operated by ARIES. It is a national facility installed at Devasthal in the district of Nainital, India.
Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, has three telescopes: Sampurnanand Telescope, Devasthal Fast Optical Telescope (DFOT), and Devasthal Optical Telescope (DOT).
The Sampurnanand Telescope has remained one of the most reliable optical telescopes in India to carry out sky scanning for continuous observations of galaxies, star clusters, Gamma Ray Bursts (GRBs), star-forming regions, Active Galactic Nucleus (AGN) and more. **So, Statement 3 is not correct**.

91. Consider the following statements with respect to High Altitude Pseudo Satellites :
    1. They are unmanned solar-powered vehicles operating in the troposphere.
    2. They are designed to bridge the gap between unmanned aerial vehicles flying at lower altitudes and conventional satellites in space.
    3. The aeroplanes, airships and balloons can act as High Altitude Pseudo Satellites.

    Which of the statements given above are correct ?
    (a) 1 and 2 only
    (b) 1 and 3 only
    (c) 2 and 3 only
    (d) 1, 2 and 3

EXPLANATION:

High Altitude Pseudo Satellites are like drones, except that they are expected to be in the stratosphere (not troposphere)– well above where commercial planes fly – and can be powered enough by solar cells and a battery system to be able to hover for days on end.
A fully working HAPS can be used for various applications, from surveillance to beaming 5G waves. They can double up as "towers in the sky" and have more flexibility than satellites in being able to map a piece of land from above. **So, Statement 1 is not correct.**

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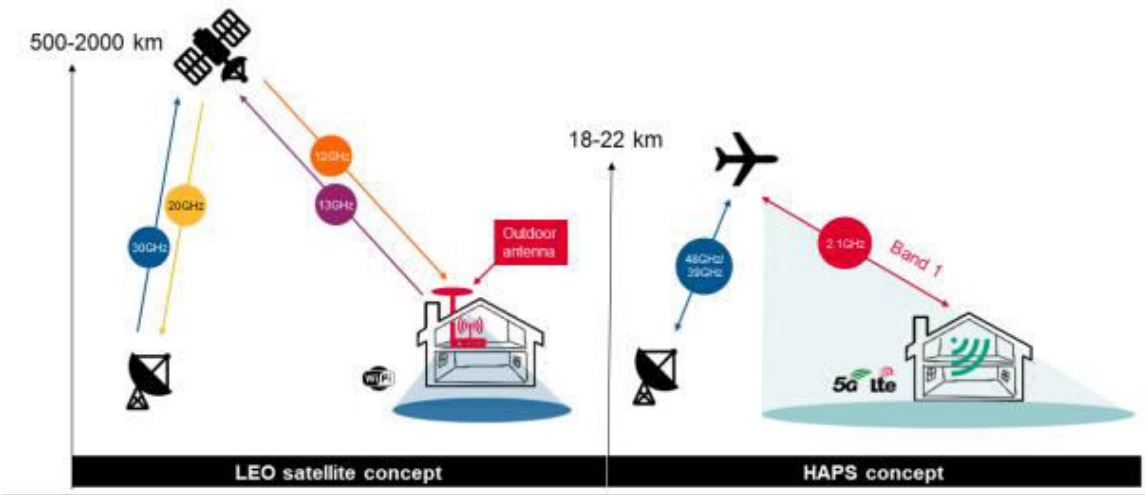

High Altitude Pseudo Satellites are unmanned aircraft operating in the stratosphere at altitudes of approximately 65,000 ft or above. These solar-powered vehicles have been designed to plug the missing link between unmanned aerial vehicles (UAVs) flying in lower altitudes and conventional satellites in space.

Stationed in a fixed place, these long-endurance flights – lasting months or even years, help provide versatile intelligence, surveillance and reconnaissance (ISR) options, thereby eliminating the performance and capability limitations of satellites. **So, Statement 2 is correct.**

There are a few options for HAPS vehicles. Balloons are the smallest, most lightweight choice, requiring the least power but offering the least control. Fixed-wing vehicles, more like planes, provide more precision. Airships are larger and more precise. The more extensive a HAPS vehicle gets, the more operational complexity is involved.

These HAPS vehicles can be categorized in two ways. The lighter-than-air (LTA) HAPS vehicles rely on buoyancy to lift off and stay afloat. Heavier than air (HTA) HAPS are fixed-wing aircraft-type vehicles with a more conventional take-off method. HAPS fly or float, depending on whether they are free-floating balloons, airships, or powered fixed-wing aircraft. Powered HAPS vehicles may use solar power or onboard energy such as a battery. All HAPS vehicles are controlled from the ground. **So, Statement 3 is correct.**

ADDITIONAL INFORMATION:

THE CURRENT AND TARGET APPLICATIONS FOR HAPS VEHICLES	
About	Search and rescue missions. ➢ HAPS vehicles travel closer to the Earth than satellites but can loiter locally more readily than other aircraft. This means that they are excellent tools for observation, including search and rescue missions.

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Disaster relief

- HAPS vehicles can offer live situation reports and even replace failed communication networks, making them ideal for disaster relief. Interlinked HAPS vehicles offer potential advantages as they can provide services with minimal ground network infrastructure, which is ideal when a disaster is unfolding or expected to occur.
- Environmental monitoring
- Continuous, real-time monitoring of environmental areas is critical to protect against natural and human threats. Be it fire, flooding, poachers or other illegal activities; many things can happen without a watchful eye, especially in challenging terrain or when there is a lack of available human resources.
- HAPS vehicles can fill in the gaps for environmental monitoring with a continuous flow of data with low latency. HAPS vehicles can cover a vast area, scanning, detecting, and tracking concerns. Any issues can be sent to a ground team, who can move in or take action.

Agriculture

- HAPS vehicles work much like drones for agriculture, allowing monitoring and management. They again offer real-time information with reliable imagery and low latency, ensuring crops are as productive as possible.

Maritime monitoring

- HAPS vehicles are vital for surveillance, including maritime monitoring. As outlined above, they can be used for pollution monitoring, vessel detection, and search and rescue missions.

Military intelligence

- HAPS vehicles can do much for the military beyond search and rescue and maritime monitoring applications. HAPS vehicles can collect a lot of data, which, along with their wide range and high altitude, can allow for military surveillance and reconnaissance.

		Satellite for global coverage	Timer per orbit (Hours)	Time in site per gateway	Latency: RTT (ms)	Mass (Kg)	Lifetime (years)
Global Coverage	GEO	3	24	Always	600/700	~3500	15
	MEO	10-30	5-12	2-4 Hours	<150	~700	12
	LEO	100+	1.5	15 Minutes	<50	5-1000	<5-7
Spotted/ Regional Coverage	HAPS	1 aircraft ~ 12 731 Km² (70 Km radius assumed in this paper)		Always	<10	< 320 (Balloon) <100 (Aircraft)	> 5 (Balloon) > 8 (Aircraft)

92. Lipulekh Pass is situated near the trijunction of India,

(a) China and Nepal
(b) Nepal and Bhutan
(c) Bangladesh and Myanmar
(d) Myanmar and China

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EXPLANATION:

Lipulekh Pass also known as Lipu-Lekh Pass/Qiangla or Tri-Corner is a high altitude mountain pass situated in the western Himalayas with an extraordinary height of 5,334 metre or 17,500 feet. It is an International mountain pass between India, China and Nepal.

This pass is the First Indian border post to be opened for trade with China in 1992. Every Year from June to September open for cross border. This pass is also the Four officially agreed BPM (Border Personnel Meeting) point between Indian Army and People's Liberation Army of China which helps in defusing face-offs.

In ancient time, it has been used by traders, mendicants, and pilgrims traverse between Nepal and Tibet. It is also the Ancient route of Kailash Mansarover Yatra. **So, Option (a) is correct.**

ADDITIONAL INFORMATION:

MOUNTAIN PASSES IN INDIA	
Recently in News	➢ The Government of India's position on the India-Nepal boundary is well known, consistent and unambiguous. It has been communicated to the Government of Nepal.
Zoji La Pass	➢ It was the site of the Indo-Pakistan War of 1947-48 ➢ It connects the Kashmir Valley to its west with the Drass & Suru Valleys to its northeast as well as the Indus Valley located further east. ➢ It is the second highest pass on the NH 1, with the first being the Fotu La Pass.
Shipki la Pass	➢ Shipki la Pass (red triangle) marks the defile of river Sutlej which enters into the Western Himalaya from Tibet. ➢ The Himalaya on the west of this pass is called North-western Himalaya.
Nathu la Pass	➢ Nathu la is a high altitude pass situated on the old silk route at the Indo-China border, and is the favourite hotspot for the tourists in Sikkim. ➢ It is one of the three trading border posts between China and India, the other two are in Himachal Pradesh and Uttarakhand.
Banihal Pass	➢ Banihal Pass, pass in the Pir Panjal Range in the Indian-held sector of Jammu and Kashmir union territory in the northern part of the Indian subcontinent. ➢ It forms the main gateway to the Vale of Kashmir from the Indian plains.

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93. Consider the following statements with respect to supercomputers :
    1. The efficiency of the supercomputers is high at lower temperatures.
    2. Their speed is measured in "FLOPS".
    3. "Param Shivey" is fastest and largest AI supercomputer in India.

    How many of the statements given above are correct ?

    (a) Only one
    (b) Only two
    (c) All three
    (d) None

EXPLANATION:

One notable example of a supercomputer with CPUs submerged in cryogenic fluids is the ETA-10 supercomputer developed by ETA Systems in the late 1980s. It was the first and only supercomputer to use cryogenic cooling for its CPUs, specifically using liquid nitrogen to keep the processors at extremely low temperatures. Cryogenic cooling helps in significantly reducing the operating temperature, which can improve performance and energy efficiency by minimizing thermal resistance and allowing for higher processing speeds. Thus, the efficiency of the supercomputers is high at lower temperature. **So, Statement 1 is correct.**
In supercomputing, FLOPS stands for Floating Point Operations Per Second and it is an essential measure of the computational power. FLOPS is the ability of a computer to perform calculations especially those of floating-point forms and is typically used in science-oriented computations. It measures the number of such operations that the system can execute in terms of one-second computation power. Thus, the speed of supercomputers is measured in "FLOPS". **So, Statement 2 is correct.**
India's AI Supercomputer 'AIRAWAT' has been ranked at No. 75 in the world at the International Supercomputing Conference (ISC 2023) in Germany. The AI supercomputer 'AIRAWAT' is installed at Centre for Development of Advanced Computing (C-DACune. The supercomputer has been named in the 61st edition of Top 500 Global Supercomputing List released recently. Airawat PSAI, stands as India's largest and fastest AI supercomputing system, with a remarkable speed of 13,170 teraflops. PARAM Shivay, the first supercomputer assembled indigenously, was installed in IIT (BHU), followed by PARAM Shakti, PARAM Brahma, PARAM Yukti, PARAM Sanganak at IIT-Kharagpur IISER, Pune, JNCASR, Bengaluru and IIT Kanpur respectively. **So, Statement 3 is not correct**.

ADDITIONAL INFORMATION:

NATIONAL SUPER COMPUTING MISSION	
About	➢ National Supercomputing Mission (NSM) has set up to provide the country with supercomputing infrastructure to meet the increasing computational demands of academia, researchers, MSMEs, and startups. It is a first of its kind attempt to boost the country's computing power. ➢ National Super Computing Mission is steered jointly by the Department of Science and Technology (DST) and Ministry of Electronics and IT (MeitY) and implemented by the Centre for Development of Advanced Computing (C-DAC), Pune and the Indian Institute of Science (IISc), Bengaluru.

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Super computers in India under NSM

Sr. No.	Institute Name	HPC System Name	Computing Power
1	IIT(BHU), Varanasi	PARAM Shivay	838TF
2	IISER, Pune	PARAM Brahma	1.70PF
3	IIT, Kharagpur	PARAM Shakti	1.66PF
4	JNCASR, Bangalore	PARAM Yukti	1.8PF
5	IIT, Kanpur	PARAM Sanganak	1.66PF
6	C-DAC, Pune	PARAM Siddhi-AI	5.2PF/210PF (AI)
7	IIT, Hyderabad	PARAM Seva	838TF
8	NABI, Mohali	PARAM Smriti	838TF
9	IISc, Bangalore	PARAM Pravega	3.3PF
10	C-DAC, Bangalore	PARAM Utkarsh	838TF
11	IIT, Roorkee	PARAM Ganga	1.66PF
12	IIT, Gandhinagar	PARAM Ananta	838TF
13	NIT, Trichy	PARAM Porul	838TF
14	IIT, Guwahati	PARAM Kamrupa	838TF
15	IIT, Mandi	PARAM Himalaya	838TF

94. "Beamforming is a technique used to improve the signal-to-noise ratio of received signals and eliminate undesirable interference sources". In this regard, which of the following has its applications?
1. Radio Detection and Ranging (RADAR)
2. Sound Navigation and Ranging (SONAR)
3. Medical imaging
4. Seismology

Select the correct answer using the codes given below :
(a) 1 and 4 only
(b) 2, 3 and 4 only
(c) 3 and 4 only
(d) **1, 2, 3 and 4**

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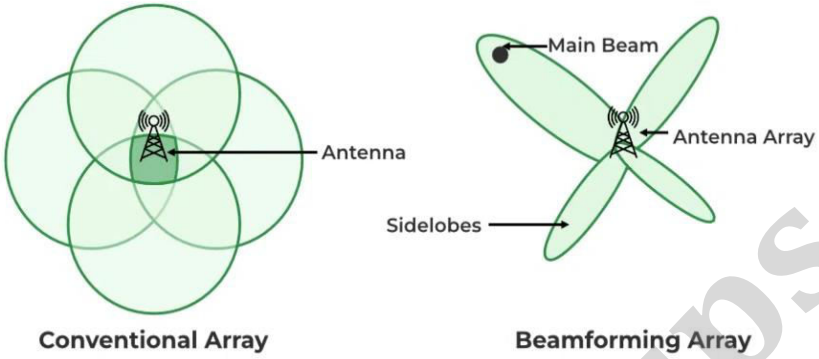
EXPLANATION:

In simpler terms beamforming is a procedure of sending electromagnetic signals in a particular direction rather than sending them in all directions by adjusting the phase and amplitude of the transmitted signals. Beamforming is formed by reinforcing the signal in a particular direction.

Applications of Beamforming:

- Wi-Fi Networks
- Cellular Networks
- Radar Systems
- Sound Navigation and Ranging (SONAR)
- Satellite Communication
- In seismic applications, beamforming helps to locate seismic sources more accurately by focusing on specific directions and reducing interference from surrounding noise.
- Medical Imaging, etc.

So, Option (d) is correct.



ADDITIONAL INFORMATION:

BEAMFORMING	
Types of Beamforming	There are two types of beamforming ➢ Analog beamforming ➢ Digital beamforming Analog Beamforming: ➢ In analog beamforming, the phase and amplitude variation is applied to the analog signal to create a directional beam. This technique is used in older wireless communication systems and the signals from different antennas are summed up before the ADC conversion at the receiver's end. Digital Beamforming: ➢ In digital beamforming, the phase and amplitude variation is applied to the digital signal before Digital to analog conversion at the transmitter's end to create a directional beam. This technique is used in modern wireless communication systems and is more flexible than analog beamforming.
Advantages	It Improves signal quality. The range of the signal Increases. Perform better in crowded environments
Disadvantages	It can be effective only within a limited range. ➢ Its performance can be affected by environmental factors such as buildings, walls, rain, and other obstructions. Multiple antennas imply high hardware costs.

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95. If a person holds a handkerchief close to his eyes and looks at the sun, it looks like circular fringes. Which of the following phenomena is responsible for the above description ?

(a) **Diffraction of light**
(b) Interference of light
(c) Scattering of light
(d) Polarisation

EXPLANATION:

At the edges of the aperture or the obstacle, light bends into the shadow region and does not propagate along a straight line. This bending of light around the edges of an obstacle is known as diffraction.

- Look at the street light at night and almost close your eyes. What do you see? The light will appear to streak out from the lamp/tube. This happens due to light's diffraction (bending) around the corners of your eyelids.
- Another way to observe diffraction is to use a handkerchief. Hold it close to your eyes and look at the Sun or a lamp. You will observe circular fringes, which form due to the diffraction of light by small apertures formed by crissed-crossed threads.

Based on the above observations, it is easy to understand why we normally do not observe light's diffraction and why light appears to travel in a straight line. You know that the wavelength of light is of the order of 10–6 m. Therefore, to observe light's diffraction, we need obstacles or apertures with dimensions of this order.**So, option (a) is correct.**

96. Consider the following statements :

As per the Central Civil Services (Leave) (Amendment) Rules, 2024

1. A surrogate mother who is a government employee and has fewer than two surviving children can take 180 days of maternity leave.
2. It also allows both male and female government employees to take maternity leave if they have children through surrogacy.

Which of the above statements is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

EXPLANATION:

Recently amendments were made in the in Civil service (Leave) Rules, 1972. These rules may be called the Central Civil Services (Leave) (Amendment) Rules, 2024. In case of surrogacy, the surrogate, as well as the

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commissioning mother with less than two surviving children, may be granted maternity leave of 180 days, in case either or both of them are government servants,". **So, Statement 1 is correct**.
Till now, there were no rules to grant maternity leaves to women government employees in case a child was born through surrogacy. The Central Civil Services (Leave) (Amendment) Rules, 2024 allows the "commissioning mother" (the intending mother of the child born through surrogacy) with child care leave besides paternity leave of 15 days to the "commissioning father", according to the changes made in the Central Civil Services (Leave) Rules, 1972. "In case of a child begotten through surrogacy, the commissioning father who is a male government servant with less than two surviving children may be granted paternity leave of 15 days within the period of 6 months from the date of delivery of the child," the new rules said. In case of surrogacy, the commissioning mother with less than two surviving children, may be granted child care leave. **So, Statement 2 is correct**.

ADDITIONAL INFORMATION:

The Central Civil Services (Leave) (Amendment) Rules, 2024	
Recently in news	➢ Till now, there were no rules to grant maternity leaves to women government employees in case a child was born through surrogacy. ➢ According to the changes made in the Central Civil Services (Leave) Rules, 1972, it has allowed the "commissioning mother" (the intending mother of the child born through surrogacy) with child care leave besides paternity leave of 15 days to the "commissioning father".
Amendments	The changes made in the Central Civil Services (Leave) Rules, 1972 are ➢ "In case of surrogacy, the surrogate, as well as the commissioning mother with less than two surviving children, may be granted maternity leave of 180 days, in case either or both of them are government servants," ➢ In case of a child begotten through surrogacy, the commissioning father who is a male government servant with less than two surviving children may be granted paternity leave of 15 days within the period of 6 months from the date of delivery of the child," ➢ In case of surrogacy, the commissioning mother with less than two surviving children, may be granted child care leave. ➢ Existing rules allow "a female government servant and single male government servant" child care leave for a maximum period of 730 days during entire service "for taking care of two eldest surviving children, whether for rearing or for looking after any of their needs, such as education, sickness and the like".
Surrogate Mother	➢ The "surrogate mother" shall mean the woman who bears the child on behalf of the commissioning mother
Commissioning Father	➢ The "commissioning father" would mean the intending father of the child born through surrogacy

97. With reference to types of asteroids in the solar system, consider the following statements :
    1. Carbonaceous asteroids, or C-type asteroids, are the most common of all asteroid types.
    2. Metallic M-type asteroids are more common than stony S-type asteroids.
    3. C-type asteroids are the primary building blocks of terrestrial planets like the earth.

    Which of the statements given above is/are correct ?
    (a) **1 only**
    (b) 1 and 3 only
    (c) 2 only
    (d) 2 and 3 only

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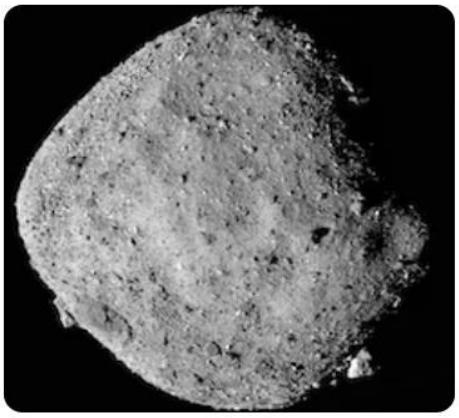
EXPLANATION:

C-type asteroids are also known as carbonaceous, or chondrite asteroids. They are the most common type of asteroid, account for about 75% of all known asteroids and predominantly occupy the outer portion of the asteroid belt. C-type asteroids, or carbonaceous asteroids, are a class of asteroids that are rich in carbon and represent some of the oldest materials in the solar system. These asteroids are primarily found in the outer regions of the asteroid belt and are thought to have formed from the primordial material that also gave rise to planets. Due to their composition, c-type asteroids provide valuable insights into the early solar system and the building blocks of planetary bodies. Chondrites are some of the oldest materials in the solar system and are believed to be the building blocks for planets. **So, Statement 1 is correct.**



Asteroid 101955 Bennu is a C-type

M-type asteroids are typically found around the middle of the asteroid belt. They account for most of the rest of the known asteroids, and while the composition of some M-types is unknown, they're thought to be primarily comprised of nickel-iron. Some also contain small amounts of stone. The composition of these asteroids can vary, depending upon their distance from the Sun when they formed. It's possible that those that formed closer to the Sun, where temperatures are higher, may have partially melted, causing iron to sink to the centre and lava to rise to the surface.

The second most common type, next to C-type asteroids is the stony S-type asteroids, which account for about 17% of all known asteroids. Metallic M-type asteroids less common than stony S-type asteroids. **So, Statement 2 is not correct.**

Asteroid 21 Lutetia is an M-type asteroid about 100km in diameter. Credit: ESA

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Compositional differences among asteroids arise from how far from the sun they formed. The C-type asteroids represent leftover building blocks of the outer solar system's gas and ice planets, whereas the S-type asteroids are the primary building blocks of terrestrial planets like Earth" in the inner solar system. **So, Statement 3 is not correct.**

ADDITIONAL INFORMATION:

ASTEROIDS	
About	Asteroids are rocky in nature, but not all rock is the same. Bouncing radar signals off asteroids as they pass by the Earth can provide clues to their composition and, their type. There are three main groups, based upon the composition of the asteroid: C – Chondrite, clay and silicate rocks S – Stony, silicate materials and nickel-iron M – Metallic, nickel-iron
S-Types, the Stony Asteroids	➢ The second most common type, stony asteroids account for about 17% of all known asteroids. Most of the asteroids found in the inner asteroid belt – at a distance of about 2.2 AUs from the Sun – are S-types, but they can also be found in the middle of the belt, at around 3 AUs from the Sun. ➢ Stony asteroids are primarily comprised of a metallic nickel-iron and magnesium silicate mixture and are brighter than their more common C-type cousins. ➢ Specifically, they reflect about 20% of the Sun's light, with the brightest being visible in binoculars. The asteroid 7 Iris is the brightest of this type, and the second brightest asteroid overall. The NEAR-Shoemaker space probe encountered the S-type asteroid 433 Eros in 2000. Credit: NASA/JHUAPL

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98. Consider the following pairs :

	Types of Artificial Neural Networks		***Uses***
1.	Convolutional Neural Networks	-	Speech recognition
2.	Recurrent Neural Networks	-	Image and video processing
3.	Generative Adversarial Networks	-	Deep fake
4.	Generative Pre-trained Transformer	-	Natural language processing

Which of the pairs given above are correctly matched ?

(a) 1 and 2 only
(b) 1 and 3 only
(c) **3 and 4 only**
(d) 2 and 4 only

EXPLANATION:

Convolutional neural networks are distinguished from other neural networks by their superior performance with image, speech, or audio signal inputs.
Prior to CNNs, manual, time-consuming feature extraction methods were used to identify objects in images. However, convolutional neural networks now provide a more scalable approach to image classification and object recognition tasks, leveraging principles from linear algebra, specifically matrix multiplication, to identify patterns within an image. They can be computationally demanding, requiring graphical processing units (GPUs) to train models.
For example, recurrent neural networks are commonly used for natural language processing and speech recognition whereas convolutional neural networks (ConvNets or CNNs) are more often utilized for classification and computer vision tasks. **So, Pair (1) is not correct.**

A recurrent neural network or RNN is a deep neural network trained on sequential or time series data to create a machine learning (ML) model that can make sequential predictions or conclusions based on sequential inputs.
An RNN might be used to predict daily flood levels based on past daily flood, tide and meteorological data. But RNNs can also be used to solve ordinal or temporal problems such as language translation, natural language processing (NLP), sentiment analysis, speech recognition and image captioning. Convolutional Neural Networks (CNNs) are a type of artificial neural network that are commonly used for image and video processing. **So, Pair (2) is not correct.**

A generative adversarial network (GAN) is a machine learning (ML) model in which two neural networks compete with each other by using deep learning methods to become more accurate in their predictions. GANs typically run unsupervised and use a cooperative zero-sum game framework to learn, where one person's gain equals another person's loss. In video production, GANs can be used to perform the following:

- Model patterns of human behavior and movement within a frame.
- Predict subsequent video frames.
- Create a deepfake.

Other use cases of GANs include text-to-speech for the generation of realistic speech sounds. Furthermore, GAN-based generative AI models can generate text for blogs, articles and product descriptions. These AI-generated texts can be used for a variety of purposes, including advertising, social media content, research and communication. **So, Pair (3) is correct.**

Generative pre-trained transformers (GPT) are neural network models trained on large datasets in an unsupervised manner to generate text. GPTs use transformer architecture and are pre-trained using a self-supervised objective to predict the next word in a sequence, given all previous words. This gives the models an in-depth understanding of natural language structure that can then be leveraged for various downstream NLP tasks.
Generative pre-trained transformers are important because they represent a major advance in natural language processing. The scale of compute and data used to pre-train them allows GPT models to attain very broad and deep understanding of language structure and content. **So, Pair (4) is correct.**

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ADDITIONAL INFORMATION:

NEURAL NETWORK	
About	➢ A neural network is a machine learning program, or model, that makes decisions in a manner similar to the human brain, by using processes that mimic the way biological neurons work together to identify phenomena, weigh options and arrive at conclusions. ➢ Neural networks are sometimes called artificial neural networks (ANNs) or simulated neural networks (SNNs). They are a subset of machine learning, and at the heart of deep learning models. ➢ Every neural network consists of layers of nodes, or artificial neurons—an input layer, one or more hidden layers, and an output layer. Each node connects to others, and has its own associated weight and threshold. ➢ If the output of any individual node is above the specified threshold value, that node is activated, sending data to the next layer of the network. Otherwise, no data is passed along to the next layer of the network. ➢ Neural networks rely on training data to learn and improve their accuracy over time. ➢ Once they are fine-tuned for accuracy, they are powerful tools in computer science and artificial intelligence, allowing us to classify and cluster data at a high velocity. ➢ Tasks in speech recognition or image recognition can take minutes versus hours when compared to the manual identification by human experts. ➢ One of the best-known examples of a neural network is Google's search algorithm.

99. Consider the following :
    1. Cloud burst
    2. Hailstorm
    3. Heat waves
    4. Pest attack
    5. Cold waves

    How many of the disasters listed above are made eligible for funding from the National and State Disaster Response Funds in India ?
    (a) Only two
    (b) Only three
    (c) Only four
    (d) All five

EXPLANATION:

The Government of India supplements the effort of the State Government by providing assistance for relief of immediate nature through two ways as per established procedure. They are
- State Disaster Response Fund (SDRF).
- National Disaster Response Fund (NDRF).

The allocation of funds under SDRF and NDRF is based on the recommendations of the successive Financial Commissions. For SDRF, the contribution is made by the Central Government and State Governments in the ratio of 75:25 to all states, except for the NE States, Sikkim, Uttarakhand, Himachal Pradesh, Jammu and Kashmir, for which it is a 90:10 ratio, while in NDRF, the entire contribution in the fund comes from the Central Government.

Recently, Observing that the State government failed to set up the State Disaster Response Fund (SDRF) for the past 13 years and even after several directions by the court in this regard since July 2019. The Karnataka High Court directed the Chief Secretary to file an affidavit on complying with the court's directions on the effective implementation of the Disaster Management Act, 2005.

The following are the Disasters covered under the SDRF & NDRF: They are

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- Cyclone
- Drought
- Earthquake
- Fire
- Flood
- Tsunami
- Hailstorm
- Landslide
- Avalanche
- Cloudburst
- Pest attacks
- Frost and Cold waves.

Heat waves are yet to be included to the list eligible for funding from the National and State Disaster Response Funds in India. **So, Option (c) is correct.**

100. Consider the following :
1. Sariska
2. Dampa
3. Pench
4. Melghat

Arrange the Tiger Reserves mentioned above in the North to South Direction using the codes given below :

(a) 3 – 1 – 2 – 4
(b) 2 – 3 – 1 – 4
(c) 4 – 3 – 1 – 2
(d) 1 – 2 – 3 – 4

EXPLANATION:

- Sariska Tiger Reserve or Sariska National Park is one of the biggest and most renowned Tiger reserve in Northern India. The park is located in the Alwar district of Rajasthan, which is about 107 km from Jaipur.
- **Dampa Wildlife Sanctuary is the biggest wildlife sanctuary in the north eastern state Mizoram. It was declared a Tiger Reserve in** 1944. It is located in the Kolasib district of the state and shares its border with Bangladesh. Sprawling over an area of 550 sq km, the sanctuary shelters a wide variety of flora and fauna. The landscape of the sanctuary is dotted with hills, valleys, forest and streams.
- Pench National Park is located in the magical land of Madhya Pradesh which falls in the districts of Seoni and Chhindwara bordering Maharashtra. Rose from the status of sanctuary to national park, it snuggled in the lower southern region guarded with the hilly topography and with assorted teak forested area widely found in this region, it reaches Satpura hills which are named after the River Pench, flowing through the centre park from North to South direction and is a lifeline of Pench Tigers.
- Melghat tiger reserve is located in the Amaravati district of Maharashtra. Melghat Tiger Reserve is located on the southern offshoot of the Satpura Hill Range in Central India, called Gavilgarh Hill. It is 225 km west of Nagpur. It was established as a wildlife sanctuary in 1967, and was declared a tiger reserve in 1974.

Tiger Reserves mentioned above in the North to South Direction are Sariska Tiger Reserve > Dampa Wildlife Sanctuary > Pench National Park > Melghat tiger reserve. **So, Option (d) is correct.**

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